

MILITARY SYSTEMS DESIGN

MAY-JUNE 1961

featuring:

Emissivity Enhancement of Solar Cells

Immersed Lead-Sulfide Detector

Electroluminescent Panel

Multi-Mode Storage Tube

Measurement of Flutter

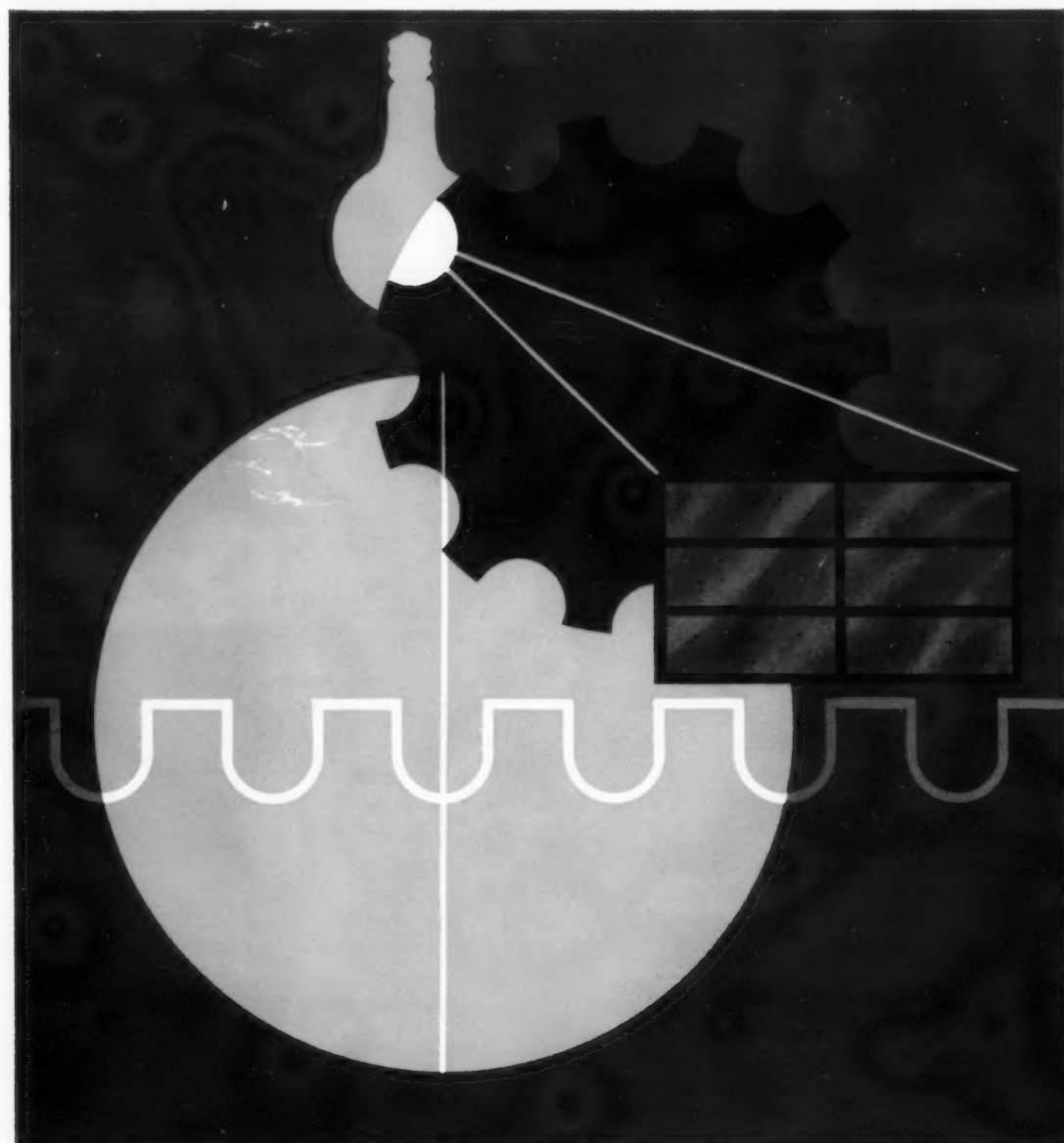
Electronic Circuitry

Sun-powered Flasher
RF Conduit Locator
Logarithmic Amplifier
Constant Current Supply
Photo-Resistor Relay
Ion Probe Cathode Follower
Phantastron Circuit
Avalanche-Mode Discriminator

cover article:

*Control Applications for
Silicon Solar Cells*

ROUTE THIS COPY TO



INSTRUMENTS PUBLISHING COMPANY • PITTSBURGH 12, PENNSYLVANIA

FOR MICROWAVE
RELAY SERVICE:

NOW 3 TUBES DO THE JOB OF 23!

Varian Associates' VA-244 series of reflex klystrons is designed for versatility in microwave relay applications. Three high-performance tubes can do jobs which formerly required 23 different types. They're engineered for flexibility, ideal for equipment in the common carrier bands. Series covers the microwave spectrum from 5.8 to 7.9 kMc. Use VA-244 series klystrons as transmitter tubes with average power output of 1 watt. As local oscillators, they operate at reduced voltages, with average power output of 60 milliwatts. Reliable, exceptionally stable, fully conduction-cooled. Low FM distortion, improved single-screw tuning.



SHOWN ACTUAL SIZE

FREQUENCY RANGE

- TUBE #1:** VA-244A 5.8-6.6 kMc
TUBE #2: VA-244B 6.5-7.3 kMc
TUBE #3: VA-244C 7.1-7.9 kMc

The versatility of the VA-244 series minimizes manufacturers' and customers' stocking problems. Order in quantity to take advantage of price reductions. For technical data, write Tube Division.



VARIAN associates

PALO ALTO 9, CALIFORNIA

BOMAC LABORATORIES, INC.
VARIAN ASSOCIATES OF CANADA, LTD.
S-F-D LABORATORIES, INC.
SEMICON ASSOCIATES, INC.
SEMICON OF CALIFORNIA, INC.
VARIAN A.G. (SWITZERLAND)

Published bimonthly by Instruments Publishing Company Inc., 845 Ridge Ave., Pittsburgh 12, Pa. Printed at 1600 N. Main St., Pontiac, Ill.

BPA

Richard Rimbach, Publisher

Claude O. Morrison, Editor
(Commander U.S. Naval Reserve)

Milton H. Aronson Editorial Director
Fred D. Marton Associate Editor
Josephine Martin Associate Editor
Raymond C. E. Smith Art Director
Robert E. Becko Production Manager
Main Office: 845 Ridge Ave, Pgh 12, Pa.,
Fairfax 1-0161

Richard Rimbach, Jr., Vice-President, Sales,
New York, Murray Hill 8-0980

Advertising Representatives

Boston 16—Harold H. Short, Jr., 269 Maine St., Stoneham, Mass., 438-3982

Chicago 6—Harold W. Haskett, Madison Terminal Bldg., 9 S. Clinton St. Central 6-8963.

Clearwater, Florida—Evert F. Nordstrom, 1651 Sherwood St., Clearwater 441-9033

Cleveland (Shaker Heights) 22—Max G. Bauer, 3310 Warrensville Center Rd. Wyoming 1-7145

Los Angeles 34—John J. Fahey, 2639 S. La Cienega Blvd., Upton 0-8442

New York 17—Richard Rimbach, Jr., Room 359, 525 Lexington Ave. Murray Hill 8-0980

Pittsburgh 12, Penna.—R. Brandergee 845 Ridge Ave., Fairfax 10161

Philadelphia 4—Robert V. Frey, Suite 100, 101 N. 33rd St., Evergreen 2-3878

San Francisco 11—Charles Clark, 420 Market St., Douglas 2-3899

St. Louis 1—Steve Wright, Room 416, 4 N. 8th St., Chestnut 1-1965

Subscriptions

Circulated without charge to qualified engineers and executives in organizations which develop, manufacture, purchase, install, or maintain electronic and control equipment and systems for military applications; officers and engineers in the Armed Forces responsible for design specification, test, or maintenance of such equipment; scientists and engineers in development and research for the Armed Forces. Qualified individuals in the United States may request this publication by providing the following information on their company letterhead: Your name and title; your job function as related to your company's products or services for the military; your company's name, address, and nature of business as related to military end products or applications. Available to others, by subscriptions, at the rate of \$10 per year.

Copyright 1961

by Instruments Publishing Company, Inc.

CIRCLE 1 ON READER-SERVICE CARD

GOERZ OPTICS SERVE

THE ROCKET AND MISSILE INDUSTRY

Whatever your optical needs—
Tracking — Reconnaissance —
Plotting — Photo Interpretation
— Mapping — the uniformly
high quality of GOERZ lenses
is your guarantee for reliable
performance.

• PLANIGON • AEROTAR
• HYPERGON • XENOTAR
• AEROGOR

Let us know your requirements



C. P. GOERZ AMERICAN OPTICAL CO.

INWOOD 96, L. I., N. Y.

CIRCLE 2 ON READER-SERVICE CARD

May-June, 1961

M S D MILITARY SYSTEMS DESIGN

PRINT ORDER THIS MONTH:

VOL. 5, NUMBER 3
May-June 1961

Emissivity Enhancement of Solar Cells for Temperature Control 2

ELECTRONIC CIRCUITRY

Sun-powered Flasher	4
RF Conduit Locator	4
Logarithmic Amplifier	4
Constant Current Supply	5
Photo-Resistor Relay	6
Ion Probe Cathode Follower	7
Phantatron Circuit	8
Avalanche-Mode Discriminator	9

All-Plastic Electroluminescent Panel 10

Multi-Mode Storage Tube 12

Immersed Lead-Sulfide Detector 14
E. W. WARSAW, JR.

Ultra-Stable Oscillator 15

Control Applications for Silicon Solar Cells 16
RICHARD L. MOLAY

Infrared Sensors Stabilize Spacecraft 18

Miniature Oscilloscope 20

Shaft Position-to-Digital Encoders 24

Measurement of Flutter 32

Power Nomogram for Rigid Coax 35

Resistor Noise 45

IR Lens, Window Material 48

Uncooled IR Detector 50

Transistorized Logic Circuits 52

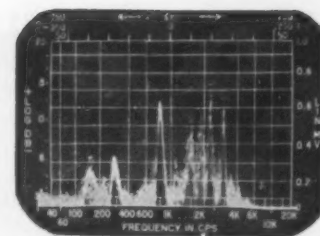
Calibrated Variable Attenuators 56

Casting of IR Components Speeds Production 63

COVER: Control of systems by Silicon Solar Cells, as utilized in satellite and less glamorous earth-bound jobs are suggested by our artist. Chopped light falling on a solar cell generates a train of voltage pulses which are displayed on the screen of an oscilloscope.

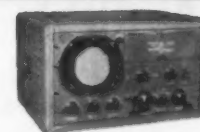
REGULAR FEATURES

New Products	44
New Literature	64
Book Reviews	34-59
Advertisers Index	Inside Back Cover
Events	Back Cover



SEE answers
to noise &
vibration analysis
problems quickly,
accurately with..

PANORAMIC'S sonic spectrum LP-1a analyzer



Rugged . . . Reliable . . . Economical

A basic component for waveform study and frequency response curve tracing, the LP-1a is widely used for: • Vibration and noise measurements • Harmonic & IM analysis • Acoustic waveform studies • Medical electronics

Check these LP-1a features:

- "Quick-look" log sweep: 40 cps to 20,000 cps in 1 second.
- Adjustable linear frequency analysis for 20 cps to 22,500 cps.
- Automatic optimized resolution with variable IF bandwidth options.
- Residual spurious down more than 60 db.
- Optional "M" internal markers at 60 cps, 500 cps and 5 kc (and harmonics).
- Optional "Z" flat face CRT, edge-lit reticule and camera mount bezel.

Write for new Catalog.



Sec. 2900



Formerly Panoramic Radio Products, Inc.
518 South Fulton Ave., Mount Vernon, N. Y.
OWens 9-4600 • TWX: MT-V-NY-5229
Cables: Panoramic, Mt. Vernon, N. Y. State

CIRCLE 3 ON READER-SERVICE CARD



NOW YOU CAN DESIGN FOR 200-300 VOLTS ACROSS ONE TANTALUM CAPACITOR *with Tansitor's new HV-Type*

Single HV-Type units are your answer when operating voltage is high but you lack space for series-connected capacitors and balancing resistors. HV tantalum capacitors give you ratings to 300 volts and 35 mfd from -55 to $+85^{\circ}\text{C}$; and to 250 volts and 25 mfd from -55 to $+125^{\circ}\text{C}$.

you get these advantages too:

LIGHT WEIGHT—SMALL SIZE

Smallest size (C1, D1 case, $\frac{3}{16}'' \times \frac{3}{4}''$).....1.5 grams
Largest size (C7, D7 case, $1\frac{1}{2}'' \times 2\frac{7}{8}''$).....35 grams

HIGH RELIABILITY

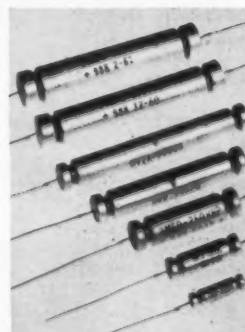
HV units feature Tansitor-type reliability, even in the toughest applications. (Last year, Tansitor's return rate on all units, for all reasons, was less than 0.01 per cent.)

LOW LEAKAGE CURRENT

Low of 32 microamps at 200 v, 0.4 mfd, $+85^{\circ}\text{C}$
Only 400 microamps at 300 v, 18 mfd, $+125^{\circ}\text{C}$

OTHER FEATURES:

Non-acid electrolyte; low power factor, low capacitance change, long shelf life and operating life from -55 to $+125^{\circ}\text{C}$; polar or non-polar construction; and optional insulating tube around case.



More Details

There's a 4-page bulletin packed with rating curves and tables waiting to tell you the full story on these new HV-type capacitors. Simply write Tansitor Electronics, Inc., Dept. 16, West Road, Bennington, Vermont or ask your Tansitor representative.



CIRCLE 4 ON READER-SERVICE CARD

Emissivity Enhancement of

Silicon solar cells are often used as an electrical power source for satellites and other space vehicles. The solar cells are fitted to a large portion of the external surface of the satellite, and absorb most of the sun's energy which falls upon them. Approximately 10% to 15% of this energy is effective in producing electrical power while the remaining energy heats the solar cells and often the satellite itself. The heat not only reduces the efficiency of the solar cells in converting sunlight into electrical power, but may impair the operation of the satellite's instrumentation. In the vacuum environment encountered in outer space, the only effective means of "cooling" the solar power pack is by reradiating the energy absorbed from the sun back into space. Fig. 1 shows the construction of a solar cell and reradiating filter.

Solar cells have a low emissivity, shown in Fig. 2, in the long wavelength range where the maximum emitted radiation would take place. Normally, 75% of the thermal emission of a black body at 50°C would take place at wavelengths greater than 9 microns.

Several methods are currently available for increasing the infrared emissivity of the cells and thereby reducing the equilibrium temperature: (1) Silicon monoxide, which absorbs strongly and emits well beyond 8μ , can be vacuum deposited onto the solar cell and anti-reflected at about 0.8μ with magnesium fluoride. The reflectance and emissivity of this coating is indicated in Fig. 2. This type of coating is inexpensive, durable, weightless and has an emissivity of approximately 0.85 in the 8μ to 18μ range. The coating has no absorption in the range of response of the solar cell; i.e., 0.4μ to 1.1μ . However, due to its thinness, this

CONSTRUCTION OF SOLAR CELL AND FILTER

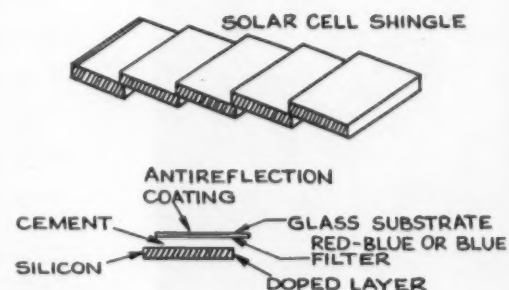


FIG. 1. SOLAR ENERGY is converted into electrical energy and into longer wavelength (heat) forms which must be re-radiated to balance satellite temperature. Solar cell and filter construction is shown at right.

MILITARY SYSTEMS DESIGN

Solar Cells for Temperature Control

coating is an ineffective emitter at very long wavelengths. (2) A cover glass slip can be cemented to the solar cell to form a rugged unit. Glass has a high emissivity (0.90) from about 4μ out to the far infrared. However, the large ultraviolet flux encountered in space tends to darken the cement. (3) An ultraviolet "blue" reflecting interference filter can be vacuum deposited on the cover glass prior to cementing to the solar cell. The filter reflects away the ultraviolet radiation which is injurious to the cement. Moreover, since the solar cell is only slightly responsive to ultraviolet radiation, the filter which reflects short wavelength radiation only slightly reduces the conversion efficiency while it considerably reduces the solar absorbance. Fig. 3 shows the transmittance of a typical "blue" reflecting filter. (4) A "red-blue" interference filter can be deposited onto cover glass for increased efficiency. The "red-blue" filter not only reflects away the "blue" end of the spectrum, injurious to the cement, but also reflects away the near infrared which tends only to heat the solar cell. By reducing the operating temperature, the conversion efficiency of the cell is increased. Fig. 4 shows the transmittance of a typical "red-blue" interference filter.

The vacuum deposited coating is durable and can generally stand any treatment that will not damage the cell itself. An evaporated coating of silicon monoxide on the metal shell of the Vanguard satellite has been successfully used for temperature stabilization in an orbit around the earth.

The cover glass slips add a degree of mechanical and particle protection when cemented to the solar cells. However, they also add weight and stress to the assembly. Large temperature changes and associated thermal expansion and contraction of the various materials as the paddles face the sun and go into eclipse must be considered in the design of the paddles. The interference filter is environmentally stable and

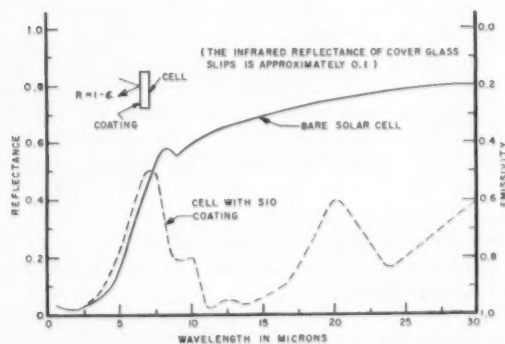


FIG. 2. REFLECTANCE and emissivity of bare solar cell is compared with reflectance of cell with vacuum-deposited SiO coating.



encapsulated between the cover glass and the solar cell where it is well protected. Recent applications employ quartz or sapphire substrates to prevent radiation damage when operating in the van Allen belt. (From 11-page Technical Report No. 1 of same title, by Dr. Joseph F. Hall, Jr., of Bausch & Lomb Military Products Division, Bausch & Lomb Incorporated, Rochester 2, N. Y.)

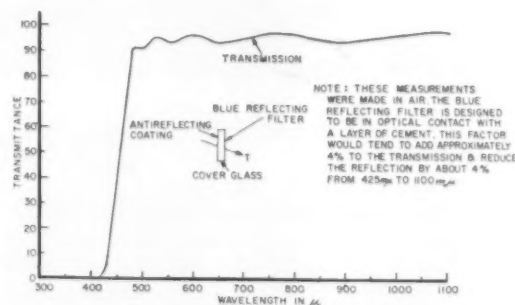


FIG. 3. TRANSMISSION of typical solar cell cover with blue reflecting coating and anti-reflecting coating.

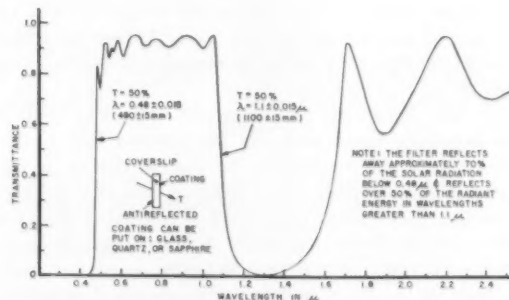


FIG. 4. TRANSMITTANCE of B & L "Red-Blue" solar Cell cover slip.

FOR MORE INFORMATION CIRCLE 106 ON READER-SERVICE CARD



PHOTOGRAPHIC AUTOMATION ROBOT



PHOTOGRAPHIC AUTOMATION ROBOT



ROBOT ROYAL S/Sa: 24 x 36mm, 24 x 24mm or 18 x 24mm frames; with coupled range/viewfinder (lenses: from 30mm to 400mm); automatic one-by-one shots or Kinographic Sequence for bursts of 5-6 frames per second.



ROBOT RECORDER: 24 x 36mm, 24 x 24mm, 18 x 24mm or 6 x 24mm frames; without range/viewfinder. OPTIONAL: rewind knob, sequence release, reticle, reflex system for double exposing second 8 x 8mm image.



ROBOT STAR II: 24 x 24mm frames; with lumiframe viewfinder (lenses from 30mm to 150mm); single motor for 20 exposures or double motor for up to 55 exposures without rewinding.



ROBOT COMPLETE ELECTRO-AUTOMATIC RECORDING SYSTEM: Royal or Recorder Camera w/30 or 200 ft. magazine; electric booster motor; camera holder; remote release; angle bracket; transformer-rectifier; intervalometer (timer) from 1/4 sec. to 24 hours.

ROBOT—THE TRADEMARK OF PHOTOGRAPHIC AUTOMATION

See your franchised ROBOT dealer or write for free illustrated brochure MSR-5.

480 LEXINGTON AVE., NEW YORK 17 • YUkon 6-4920

CIRCLE 5 ON READER-SERVICE CARD

MM MILITARY CASES

COMBINATION • TRANSIT • INSTRUMENT

MIL-T-945, T-4734, T-21200, STD-108, C-4150



OVER 1,000,000 VARIATIONS AVAILABLE NO DIE CHARGE

Your choice of over 1,000,000 variations in dimensions, proportions, metals, finishes, and custom accessories for military combination, transit, instrument and portable cases. Whatever your need, the MM (multi-measure) method gives you high production savings even on custom runs as low as 25 units. Send us your print or requirements direct or contact your MM representative.

FREE: Send for free catalog and dimension specification sheets

MM ENCLOSURES, INC.

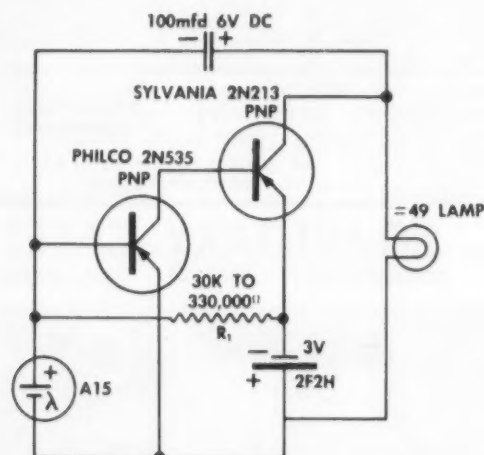
111 BLOOMINGDALE RD., HICKSVILLE, N. Y.

Electronic Circuitry

A continuing MILITARY SYSTEMS DESIGN feature, these circuits are selected because they represent good design. Significant characteristics which are not self-evident from the diagram are explained in the printed commentary.

SUN-POWERED PHOTO-ELECTRICALLY CONTROLLED FLASHER

The circuit illustrated is a self-powered, automatically switching cordless and compact flasher for use as a barricade warning light and for a number of other uses. When equipped with the silicon cell charging circuit auxiliary, and a 3-v nickel-cadmium battery it will operate indefinitely from sun power, turning itself off whenever natural illumination is above two footcandles. The flash rate can be varied from a



low rate of once per second with the maximum value of R1 to a high rate of 100 flashes per second or more with the lower value given.

C1-100 μ f 6v electrolytic condenser

T1-Philco 2N535 transistor, PNP

T2-Sylvania 2N213 transistor, NPN

R1-Flash rate control resistor 30K to 330K

PCI-Type A15 International Rectifier Corp. silicon photovoltaic cell 2" in diameter

Lamp is a #49 2 volt pilot lamp drawing only 60 ma.

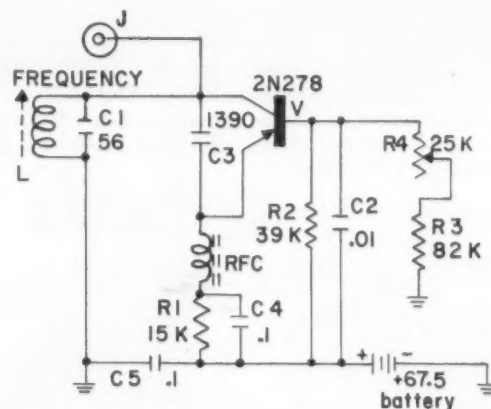
Batt.: Battery is a Burgess 2F2H 3 volt battery or equivalent. For outdoor permanent use, the battery is replaced by 3 Type S-108 Sonotone Nickel-cadmium batteries shunted by ten 1 x 2 cm Type S1020E10 International Rectifier Corp. silicon cells (PC2) in series.

Source: Solar Cell and Photocell Handbook, (1960)
111 p., 6" x 9", \$2.00 International Rectifier Corp., El
Segundo, Calif.

RF CONDUIT LOCATOR

The tone-modulated RF transmitter circuit shown in Figure, when clipped to an outlet box or water faucet will energize a buried pipe so that its location can be detected by a transistor radio receiver.

The 2N278 transistor, rated at 50 v, collector-emitter maximum, is emitter-biased with a 15K resistor which limits the current to about 4 ma. The transmitter will oscillate, but does not provide tone modulation, at a



lower voltage than the 67.5 v prescribed. The tank circuit consists of a ferrite broadcast "loop stick" antenna shunted by a 56 pf mica condenser. C3 is the feedback capacitor consisting of a 1000 pf and a 390 pf capacitor in parallel. A ceramic capacitor (0.01 μ f) is recommended as the base RF bypass unit, C2. All resistors are $\frac{1}{2}$ watt, 10% tolerance. The RFC is a TV horizontal oscillator coil, which with R1 and C4 provides audio blocking for the oscillator. Both the audio frequency and the radio frequency will be altered by adjustments of R4. The RF frequency can also be changed by adjustments of the ferrite core coil "L".

To use, adjust the RF frequency to a clear spot in the broadcast band, and clip the antenna lead to the free end of the conduit to be traced. Although the signal will not radiate any distance into the air surrounding the conduit, a sensitive transistor receiver will pick up the signal when directly over the conduit, even when buried in a concrete or plaster wall. If coupled to open wiring or to a tuned antenna-ground circuit, the transmitter is capable of creating a broadcast signal in violation of FCC regulations, which should be carefully avoided.

Input: 4 ma @ 67.5 v dc from battery.

Frequency: Broadcast band.

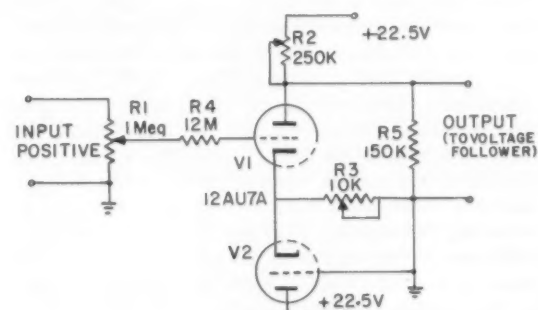
Source: Mr. Harry D. Parker, 4568 Bensen St., West Palm Beach, Florida. Also *Radio-Electronics*, Dec. 1960.

SIMPLE LOGARITHMIC AMPLIFIER

A direct coupled amplifier in which the output follows the equation

$$E_0 = 9.00 - 2 \log_{10} E_1$$

with an accuracy of 2% or better for positive input voltages from 5 to 500 v is useful in many applications including nuclear radiation measurements and analog computing systems. The circuit is easily calibrated and is stable over many hours of operation. Stock components accurate to 10% were found to be adequate in its construction.



In use, the amplifier feeds into an isolation amplifier to eliminate loading effects of an indicating voltmeter. A Philbrick Model K2-W operational amplifier used as a high impedance follower has been found satisfactory. The V1 section of the 12AU7A is the logarithmic element, while the V2 section provides a fixed bias for the cathode of V1. Variable resistances R1, R2 and R3 (linear taper) compensate for tube aging and individual differences between tubes.

To prepare the amplifier for logarithmic operation, the input is first grounded and R2 adjusted to give an output of 9.00 v. With an input of 50 volts, R1 is adjusted to give an output of 5.60 v. Using an input of 10 v, R3 is then adjusted to give an output of 7.00 v. R1 and R2 will need occasional adjusting to compensate for tube aging, but R3 will normally not require readjustment unless the tube is changed. About 100 hours of operation is required to age the tube for best stability.

Input voltage: 5 to 500 v dc

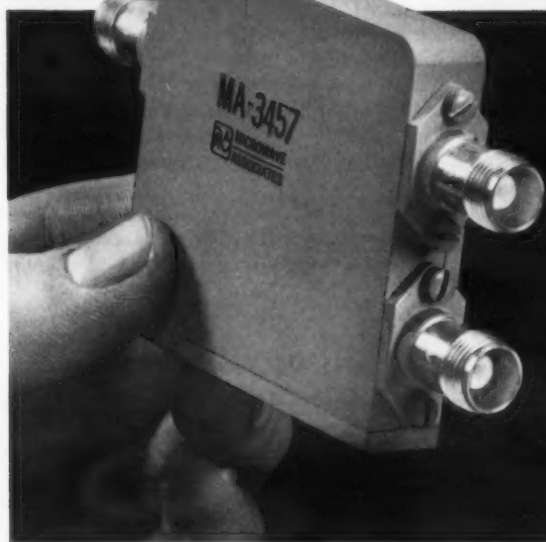
Plate Battery: 22.5 v to 18.0 v under load.

Output voltage: From 1.0 v to 5.6 v, is logarithmic function of input voltage.

Max drift zero input: 50 mv over a 30-hr period.
Max drift over logarithmic range: 2%

Source: L. V. East and W. E. Parker, Boeing Airplane Co., Wichita, Kans. Also *The Review of Scientific Instruments*, November 1960.

2 NANOSECOND MICROWAVE SWITCHING with SOLID STATE RELIABILITY



Microwave Associates' new coaxial switches provide:

- Efficient switching across the microwave spectrum
- Solid-state reliability for military applications
- Lightweight (approx. 5 oz.) ruggedized construction
- Low driving power — from 10 to 100 milliwatts
- Power handling capability $\left\{ \begin{array}{l} 4 \text{ watts CW (S.P.S.T. unit)} \\ 150 \text{ watts peak at 0.001 duty cycle} \end{array} \right.$
- Low insertion loss — as low as 0.2 db

Solid-state switches are as good as the semiconductors they incorporate. All units described use the most advanced microwave silicon diodes available, specifically developed for this function by Microwave Associates Semiconductor Division.

LOW POWER LEVEL COAXIAL SWITCHES

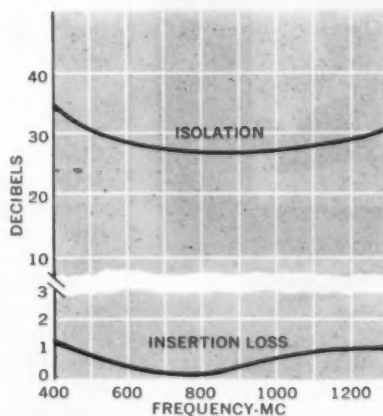
Frequency (Mc)	Insertion Loss (Max)	Isolation (Min)	Switching Power
210-240	0.2 db	20 db	10 mw
260-340	0.2 db	18 db	10 mw
400-500	0.3 db	20 db	10 mw
570-630	0.3 db	20 db	10 mw
900-1000	0.3 db	20 db	10 mw
1250-1350	0.5 db	20 db	10 mw
MEDIUM POWER LEVEL COAXIAL SWITCHES			
200-1000	1.5 db	22 db	70 mw
1000-2000	1.5 db	20 db	70 mw
2000-4000	2.0 db	16 db	70 mw

LOW POWER LEVEL VOLTAGE VARIABLE ATTENUATORS

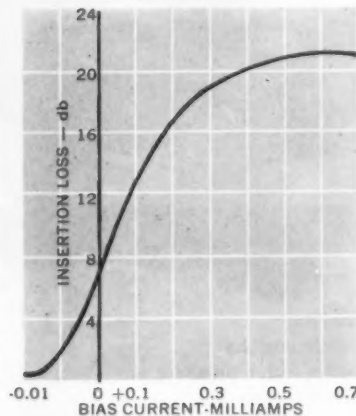
Frequency (Mc)	Attenuation Range
260-340	0.2 db-18 db
400-450	0.3 db-20 db
570-630	0.3 db-20 db
1250-1350	0.5 db-20 db

Narrow-band higher frequency units are available with lower loss and increased isolation.

TYPICAL PERFORMANCE BROADBAND MICROWAVE SWITCH SPST



TYPICAL PERFORMANCE VOLTAGE VARIABLE ATTENUATOR (425 Mc \pm 25)



Units for handling higher powers are now in development. Microwave Associates has capabilities for meeting your requirements for single-pole multiple-throw and waveguide switching devices. Our switches invite comparison. We invite your inquiries. A quotation/data sheet will be sent on request.

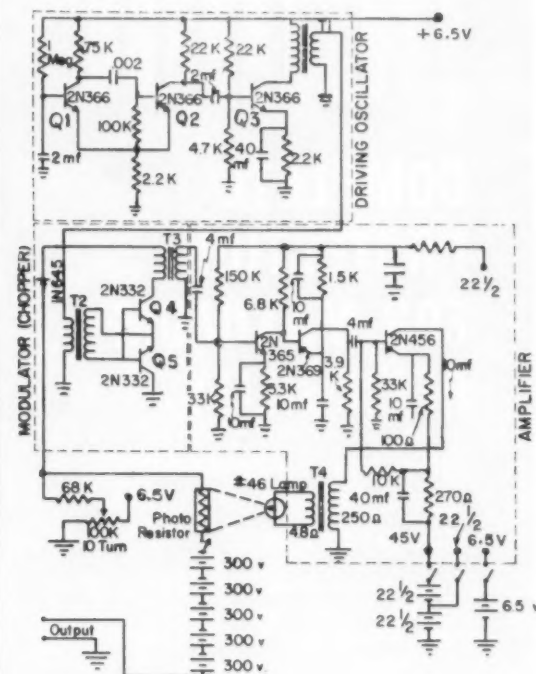
MICROWAVE ASSOCIATES, INC.
ELECTRON TUBE AND DEVICE DIVISION, Burlington, Mass.

Western Union FAX • TWX: Burlington, Mass., 942 • BRowning 2-3000

CIRCLE 7 ON READER-SERVICE CARD

CONSTANT CURRENT SUPPLY FOR HIGH RESISTANCE LOADS

Hall-effect measurements of semiconductors of very high resistivity required, in one application, a constant current generator which could be battery operated and with one side of the load grounded. The system used in the block diagram has supplied currents in the 1 to 100 μ a range with load resistances to several hundred megohms. The regulating element is a gallium arsenide photoresistor having a dark resistance of 8.4×10^8 ohms which changes to a value of 6×10^4 ohms when illuminated by a microscope lamp.



The principle of operation may be seen by reference to figure and assuming a very high resistance in the photoresistor (dark lamp). With the potentiometer R1 set at some reference voltage, say 3.4 volts, an initial current flows through R2, through D1, through point A, through the transistor chopper, and through the primary winding of T3, the input transformer to the voltage amplifier. This error signal, chopped and amplified, excites the lamp focussed on the photo-resistor. Assuming that the 68K ohms in R2 accounts for most of the resistance in this low-voltage loop, the current passing point A will be approximately 50 μ a.

As the photoresistor is illuminated, its resistance falls, causing the current drawn through the photoresistor and the high resistance load loop by the 1500 v supply to increase. This current tends to diminish the reference current flowing through point A from R1 and R2 which in turn reduces the driving signal to the illuminating lamp. For each set

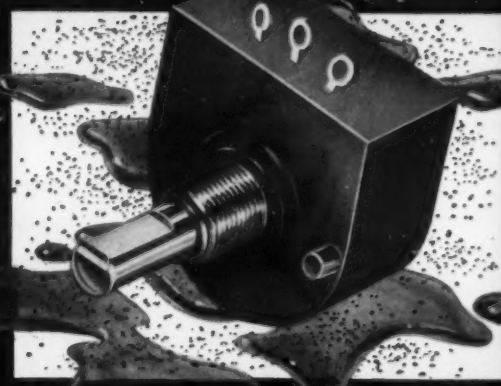
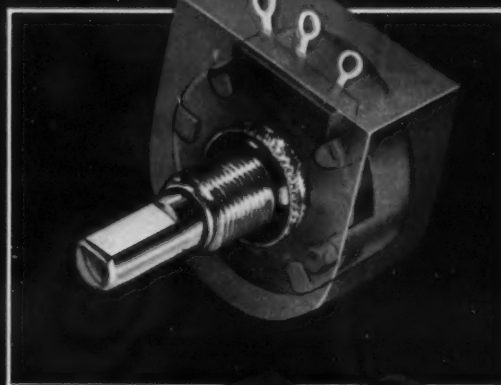
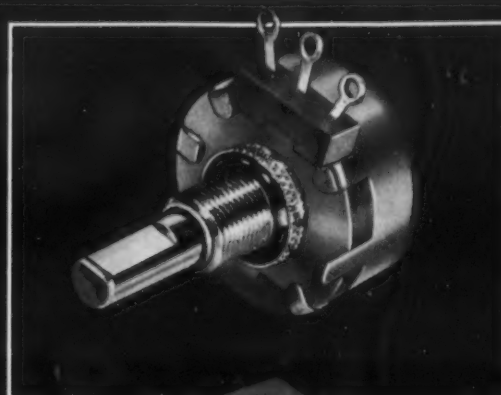
Continued on page 6

potpot

COMPLETE PROTECTION FOR MAXIMUM RELIABILITY

*PotPot super encapsulation
seals in factory-fresh performance,
seals out troubles...*

New performance reliability under the most adverse moisture, sand, dust, corrosive and explosive atmospheres, temperature cycling, low temperature storage and operating conditions, is sealed in through the Clarostat PotPot encapsulation technique. This is the answer for maximum reliability of potentiometers, switches, and other components, or combination assemblies. Potpot encapsulation meets MIL-E-52 specification.



The exclusive Clarostat PotPot encapsulation technique is available for standard Clarostat potentiometers and switches. It consists of a pre-sealing operation with a moisture test before encapsulation in a high density compound of desirable electrical and mechanical properties. Shaft and bushing assemblies are completely sealed.

*Write for complete technical information... see for yourself
how performance reliability increases through the PotPot technique...*



CLAROSTAT MFG. CO., INC.
DOVER, NEW HAMPSHIRE

CIRCLE 8 ON READER-SERVICE CARD

current there will be some amount of current at which the photocell resistance becomes small at which point A is almost at ground potential.

It is important that a reverse current through A be prevented as such an excursion would build up and send the system out of control. diode D1 prevents this reversal.

Circuit details of the constant current source shown in Figure. Q1 and Q2 form an uncoupled multivibrator producing an 800-psec or trapezoidal wave, which is amplified by Q3 signal drives the transistor chopper (Q4) which is in series with the reference voltage and the primary of T3.

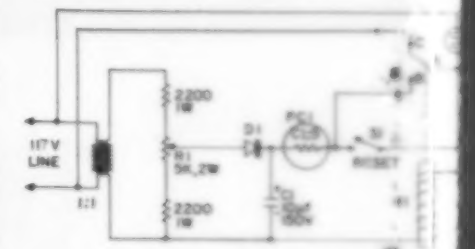
Regulation: At 10 μ A set current, 0 to 15 ohms load, 1.5%; 50 to 100 megohms load, 0.32%; 5 to 10 megohms load, 0.03%.

Recovery time: (Filament cooling) 80 msec load current of 20 μ A to 160 msec with 0.1 μ A current. (Filament heating), 20 msec for currents.

Source: Mr. R. W. Haisty, Central Research Laboratories, Texas Instruments Incorporated, Dallas, also *The Review of Scientific Instruments*, Vol. 31, 1960.

PHOTO-RESISTOR TRIGGERS RELAY

A cadmium-selenide (resistive type) photocell the sensitive element in a simple alarm circuit arranged to operate whenever the light beam from the cell is interrupted. For the type



CL-3 cell specified, with an average resistance of 160K ohms, infrared energy from a diffuse descent light source can be used to produce a "light" surveillance beam which will set off an alarm when the beam is interrupted.

Sensitivity of the circuit can be adjusted to 80 volts by R1, which is a 5,000-ohm linear-taper potentiometer. The relay is a 50-coil SPDT relay (Advance SV/1C/530/0 110 ohm). The transformer is 1:1 ratio 117V transformer (50 watts or less). The diode is Tarzian 2F-4 or equivalent rated at 400 V rms and 0.2 dc amps max.

With illumination falling on the photocell current from the adjustable voltage power source through the photocell passes through the photocell, through the switch S1 and the coil of the relay K1. When contact B, shorting out S1. If the Switch S1 is closed after relay K1 operates and light continues on the photocell the armature will be held

MILITARY SYSTEMS

6

actuated position with contact C open. If the beam is interrupted, even momentarily, the relay will release closing contact C and actuating a 117v alarm or signal light. Since the circuit through the relay coil is now opened at contact B, the alarm will stay on until switch S1 is closed to actuate the relay coil and reset the alarm circuit.

If Switch S1 is allowed to remain closed, the device will operate as a store announcer, the alarm sounding only when the light beam is interrupted.

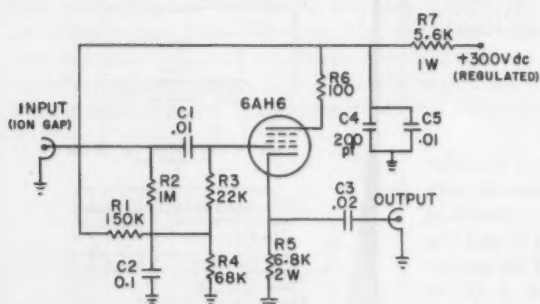
Infrared filter (Edmund Scientific Co., Barrington, N. J. Cat. No. 60,033 5 $\frac{3}{8}$ " dia x $\frac{1}{8}$ " thick glass,) can be used to filter visible light from an incandescent 116v lamp also visible light, including daylight may be used for other applications.

Source: Mr. Charles Caringella, P. O. Box 1025, Ontario, Calif. also *Popular Electronics*, Feb. 1961.

Ed. Note: Clairex engineers warn that at low illumination levels the photocell will be dissipating 75 mw, whereas it is rated at only 50 mw dissipation.

ION PROBE CATHODE FOLLOWER

Measurement of the onset of ionization of gas within a detonation tube involves the measurement between two concentric stainless steel electrodes separated by a 1/32" Teflon sleeve, all having their ends flush with the detonation chamber wall. The cathode



follower (figure) is located close (within inches) to the probe but acoustically insulated from it to avoid shock-induced pickup. The output of each cathode follower is led over a coaxial cable to a high-gain amplifier which triggers a thyratron tube.

A positive potential is applied from the 300 v regulated power supply through R7, R1 and R2 to the signal electrode. This potential collects electrons from the ionized gas, producing a negative output pulse. A rise time of 0.01 μ sec and an output impedance of less than 100 ohms over swings as large as 60 v is obtained so that cathode followers of the same type can be used at all probe positions, regardless of signal level.

Noise Output: 100 μ v. Max.

Minimum Signal: Limited only by output noise.

Maximum Signal input: 70 v. (with R7, R1 and R2 values shown)

Rise time: Approx 0.01 μ sec for signals \leq 60v.

Source: G. J. Hecht, A. J. Laderman, R. A. Stern and A. K. Oppenheim, University of California, Berkeley, Calif., also page 1110, *The Review of Scientific Instruments*, October, 1960.

Continued on page 8

VITRAMON, INC. Develops Dramatically Improved Dielectric Material

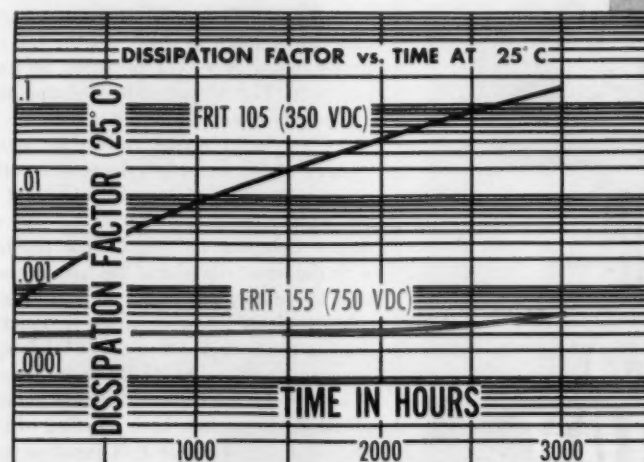


**SOLID STATE
PORCELAIN
CAPACITORS**

with NEW #155 "FRIT"

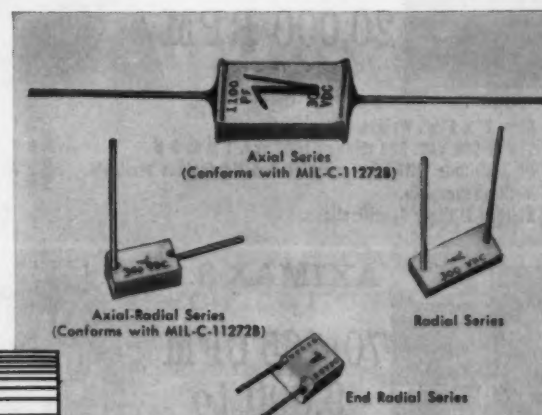
ASSURE 10 TIMES BETTER PERFORMANCE AFTER A LIFE TEST 10 TIMES MORE DEMANDING!

Three years of intensive product research, and the desire to impose a more exacting quality control during production, have resulted in the development of a new porcelain "frit." Completely formulated and produced within our own plant, this high quality dielectric material, utilized for the improved "VY" Porcelain Capacitors, has produced dramatic results.



NOTE: Offered Exclusively For MIL-C-11272B Requirements.

© Vitraron, Inc.



When tested at 125°C with more than twice previous test voltages applied (750 VDC vs 350 VDC and 450 VDC vs 200 VDC) and with the time extended to 2000 hours (more than 10 times as stringent a test) post-test dissipation factor is .002 max. and insulation resistance is greater than 100,000 megohms (10 times better!)

Vitraron®
INCORPORATED
Box 544, Bridgeport 1, Conn.

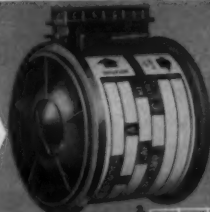
CIRCLE 9 ON READER-SERVICE CARD

AXIMAX MINIATURE 400CPS FANS

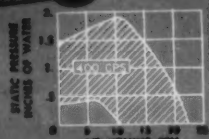
AXIMAX 1

12 to 23 CFM
11,400 to
22,500 RPM

1 13/32" x 4 OZS.



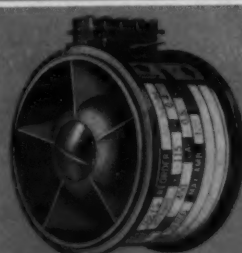
- Extremely compact and lightweight—1 13/32" x 1 1/4", 4 ozs.
- 115 or 200 VAC, 1 μ or 3 μ , 400 cps.
- Airflow reversible.
- Built to Military Specifications.



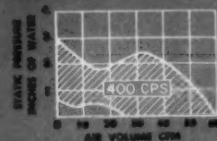
AXIMAX 2

24 to 60 CFM
8,000 to
20,000 RPM

1 15/32" x 4 1/2 OZS.



- Size: 2" x 1 1/2". Weight: 4 1/2 ozs.
- 115 or 200 VAC, 320 through 1600 cps, 1 μ or 3 μ
- High altitude (Altivar) and high density designs available.
- Airflow reversible.
- Built to Military Specifications.



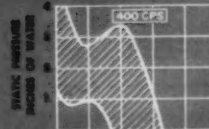
AXIMAX 3

70 to 165 CFM
9,000 to
22,000 RPM

2 5/8" x 14 OZS.



- Size: 3 1/4" x 2 3/4". Weight: 14 ozs.
- 115 or 200 VAC, 400 and other cps, 1 μ or 3 μ .
- High altitude (Altivar) and high density designs available.
- Airflow reversible.
- Built to Military Specifications.



Appropriate cam-locking mounting clamps are available from Rotron for servo-mount Aximax fans.

Write for Complete
Technical Details,
or Submit Your
Cooling Problems for
Recommendations



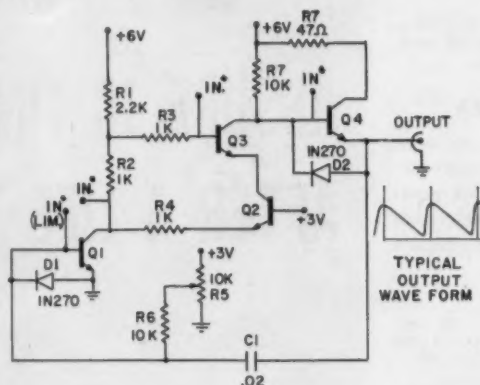
ROTRON
MANUFACTURING CO., INC.
WOODSTOCK, NEW YORK

CIRCLE 10 ON READER-SERVICE CARD

PHANTASTRON TRANSISTOR CIRCUIT

A phantatron circuit produces an output having a linear sweep, followed by a regenerative region that acts as a switch to reset the circuit at the end of a cycle.

The wide utility of the phantatron circuit makes it desirable to try to apply the principle to transistor circuits. However, since the vacuum-tube phantatron depends on controlled partitioning of the space charge current between the screen grid and plate of a multi-grid tube, this action cannot be produced by a single transistor. The circuit illustrated uses three transistors in a circuit to simulate the phantatron action. An emitter follower (Q4), and diodes D1 and D4 are added to improve recovery and linearity.



To understand the operation of the circuit consider an input signal which is slowly rising in potential with transistor Q1 initially cut off and with its collector at its maximum positive value. Q3 is forward biased but Q2 emitter is reverse biased, thus cutting off the emitter current of Q3. Since the emitter current of Q3 is practically zero, the collector current is also zero, although the base is forward biased.

As the applied signal crosses zero, the base of Q1 is forward biased and Q1 starts to conduct, causing its collector voltage to drop. As the Q1 collector voltage drops below 3 v, Q3 becomes forward biased, and conducts. The output voltage drops and is thus 180° out of phase with the input signal.

As the input signal is further increased, collector voltage of Q1 is further depressed until the voltage at point B is about +3 v. At this point the base potential of Q3 is so low that Q3 is cut off, causing the output potential to rise. Output potential is in phase with the input signal and the circuit goes into regeneration to quickly reset potentials in preparation for another cycle of linear negative feedback. During regeneration the collector current of Q1 is split between one branch consisting of R1-R2 and a second branch composed of the R4-Q2 emitter-base junction. In the cut off mode the emitter-base junction of the Q2 transistor acts as a simple diode P-N junction which has a relatively low forward resistance. This means the emitter-base current is large compared to its value when Q2 is operating as a transistor.

However, current diverted to Q2 goes to +3 volts

TRAK Type 9150S for
Plate Pulse Service

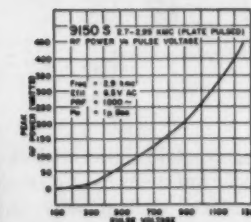
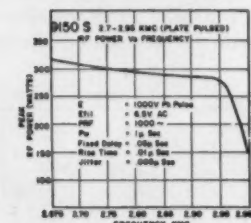


WHERE OVERALL
POWER EFFICIENCY
AND SPACE SAVING
A MUST...

THE NEW RUGGED TRAK S-BAND OSCILLATOR

Mechanically rugged enough for use in environments requiring a very high accelerative force, such as in proximity fuse work!

Performance Curves:



SPECIFICATIONS ARE:

Frequency: 2.7-2.95 KMc.
Power Output: 200 Watts peak (test conditions—1 microsec. PW, 1000 PRF).
Power Input: Epp = 1 KV Ipp = 1.0 amp
Ett = 6.5 Im = 240 ma
Duty Cycle: .0025 maximum.
Output Pulse Rise Time: 15 millimicrosec.
Output Pulse Jitter: 5 millimicrosec.
Fixed Delay: 50 millimicrosec.
Vibration: 15 G from 50-2000 cps, 3 axes, less than ± 1 Mc FM.
Shock: 100 G, 6ms, 3 axes, less than 250 Kc FM.
Temperature Stability: 2 Mc maximum drift from 0°C. to 90°C.
Mounting: Engineered to customer specifications.

Miniature Microwave Energy
Sources, engineered to your
specifications.

Write today for new Catalog
61B, full of oscillators for CW,
grid pulse and plate pulse
service.



**TRAK MICROWAVE
CORPORATION**

5006 N. Coolidge Avenue
Tampa 3, Florida
REDWOOD 6-6422

TRAK
Microwave

CIRCLE 11 ON READER-SERVICE CARD
MILITARY SYSTEMS DESIGN

supply, and does not contribute to the output. Feedback through C1 and adjustable bias for the base of Q1 through R5 allows the circuit to operate in either triggered or free-running modes.

Trigger inputs for either synchronized or pulse-triggered operation may be applied at several different points in the circuit. Recommended trigger points are the bases of Q3 or Q4, the collector of Q1 or, with adequate current limiting, the base of Q1. These points (marked by asterisks) can also be clamped by direct coupling to permit gated operation of the circuit.

Output Sweep time: 2.4 msec over linear portion.

Output Amplitudes: 3 v peak-to-peak.

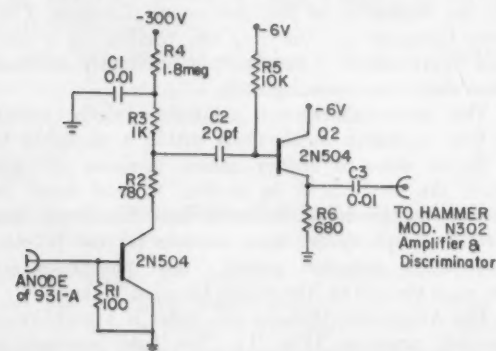
Recovery time: 10 to 30% of output cycle.

Frequency in free-running mode: approx. 2 kc max.

Source: N. C. Hekimian, Page Communications Engineers, Inc., 2001 Wisconsin Ave., N. W. Washington 7, D. C.

AVALANCHE-MODE DISCRIMINATOR

A Philco 2N504 transistor is used as a discriminator circuit following a 931-A photomultiplier tube in nuclear instrumentation (Fig. 00). This circuit, tested on a 15-day continuous counting run from a Pilot Model B plastic scintillator irradiated with a 100 microcurie Co⁶⁰ source showed only a 6.4% decrease in system gain. The output is very clean with two decades of separation between discriminated and non-discriminated pulses. The avalanche action gives a separation of about 50 to 1, the additional rejection



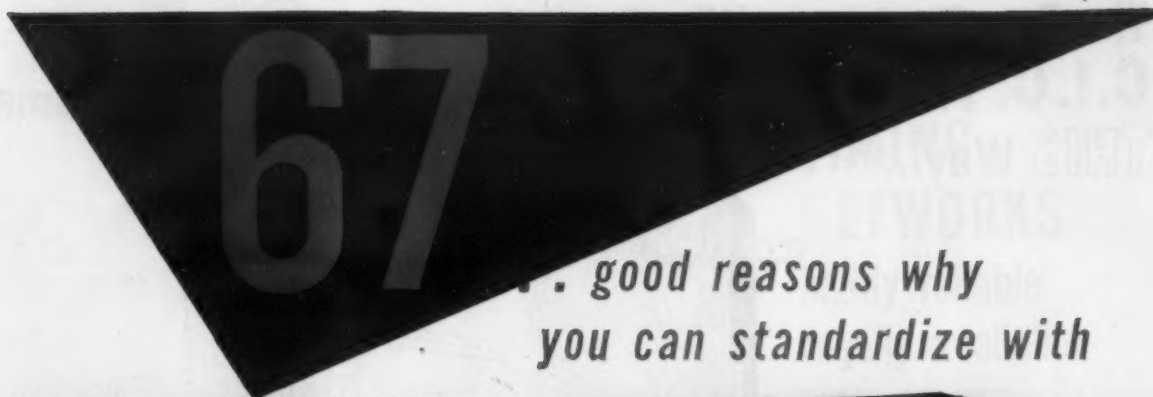
coming from the operation of the emitter-follower stage as normally saturated. Approximately 80% of all 2N504 transistors tested were found to operate satisfactorily in the avalanche mode and without oscillation, however, a later batch of 100 did not give as high a number operating well in the avalanche mode.

The Hamner Model N302 amplifier and discriminator is used to measure the pulse height distribution of the avalanche transistor output. The transistor itself gives a separation of approximately 100.

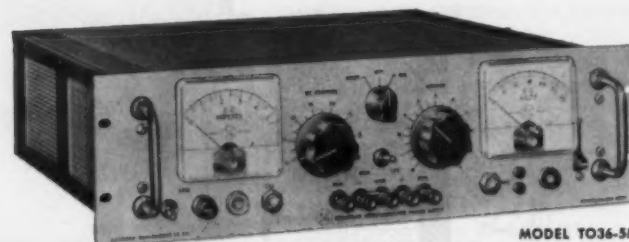
Average threshold: 0.54 v for 2 nsec trigger pulses, 0.20 v for 20-nsec triggers. Circuit will trigger in the avalanche mode on pulses from 1 nsec to slow sinusoids of 60 cps or less.

Source: Ralph Fullwood, Linear Accelerator Lab., Dept. of Nuclear Engineering and Science, Rensselaer Polytechnic Institute, Troy, N. Y.

May-June, 1961



... good reasons why
you can standardize with



MODEL TO36-5M

REGATRAN[®] SEMICONDUCTOR POWER SUPPLIES

SPECIFICATIONS

*REGULATION: 0.03% or 0.01 V from no load to full load and 105 to 125 V line. (0.1% or 0.01 V for 3-amp models.)

RIPPLE: Less than 1 millivolt rms.

INPUT: 105 V to 125 V, 50 to 60 cps.

CIRCUIT PROTECTION: Four-year field-tested electronic and electrical circuit protection.

MOUNTING: Rack and table.

*0.01% or 0.003 V regulation available on special order.

REQUEST BULLETIN 721A.



®Reg. U.S. Pat. Off. Patents Issued and Pending.

* WIDE RANGE MODELS			
D-C OUTPUT		MODEL NUMBER	DIMENSIONS IN INCHES
VOLTS	AMPS		
0-7	0-30	*TO7-30	15 1/4 19 16
0-7	0-15	*TO7-15	8 3/4 19 13
0-7	0-10	*TO7-10	7 19 13
0-7	0-5	*TO7-5	5 1/4 19 13
0-7	0-3	*TO7-3	3 1/2 19 12 1/2
0-14	0-20	*TO14-20	15 1/4 19 16
0-14	0-10	*TO14-10	8 3/4 19 13
0-14	0-7.5	*TO14-7.5	7 19 13
0-14	0-5	*TO14-5	5 1/4 19 13
0-14	0-3	*TO14-3	3 1/2 19 12 1/2
0-32	0-30	TO32-30	15 1/4 19 16
0-32	0-15	TO32-15	8 3/4 19 13
0-32	0-10	TO32-10	7 19 13
0-32	0-5	TO32-5	5 1/4 19 13
0-32	0-3	TO32-3	3 1/2 19 12 1/2
0-36	0-30	TO36-30	15 1/4 19 16
0-36	0-15	TO36-15	8 3/4 19 13
0-36	0-10	TO36-10	7 19 13
0-36	0-5	TO36-5	5 1/4 19 13
0-36	0-3	TO36-3	3 1/2 19 12 1/2
0-40	0-15	TO40-15	15 1/4 19 13
0-40	0-7.5	TO40-7.5	8 3/4 19 13
0-40	0-5	TO40-5	7 19 13
0-40	0-2.5	TO40-2.5	5 1/4 19 13
0-40	0-1.5	TO40-1.5	3 1/2 19 12 1/2

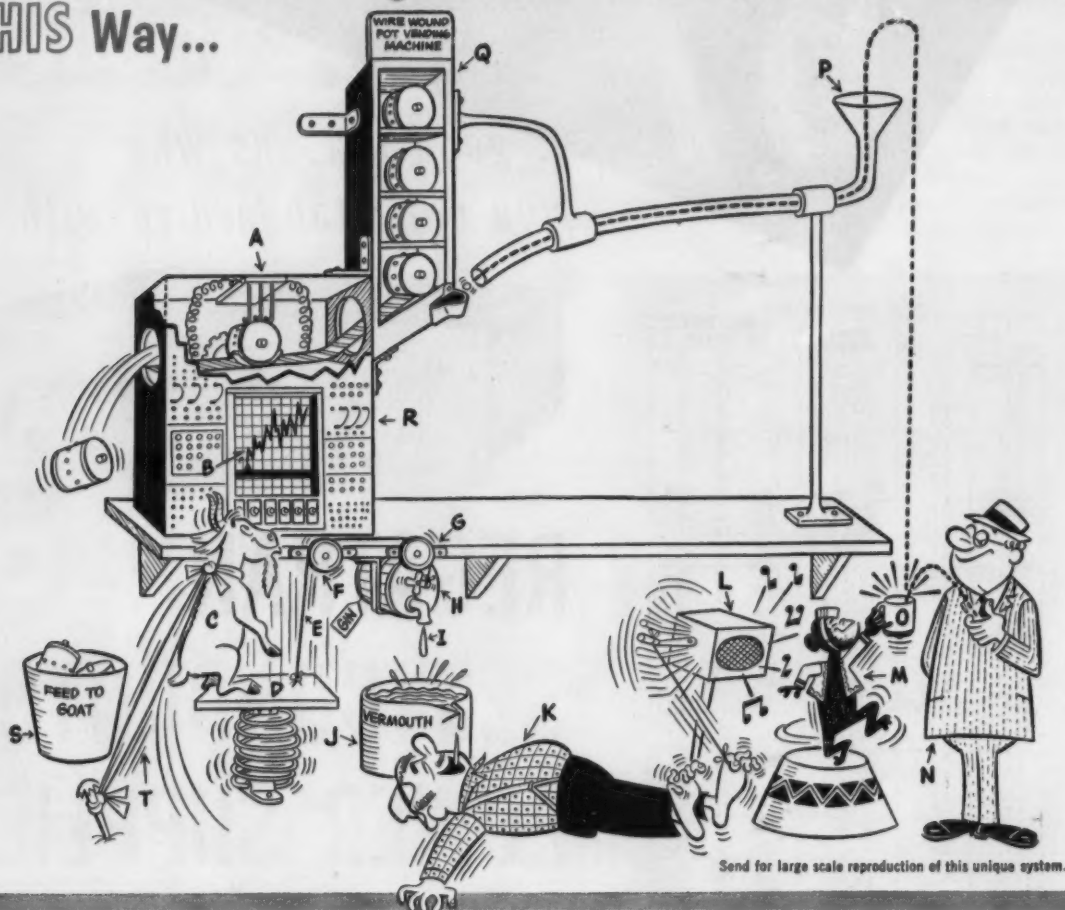
*MODELS MARKED WITH AN ASTERISK ARE PROGRAMMABLE.

1 NARROW RANGE MODELS			
2-7.5	0-30	T6-30	15 1/4 19 16
2-7.5	0-15	T6-15	8 3/4 19 13
2-7.5	0-10	T6-10	7 19 13
2-7.5	0-5	T6-5	5 1/4 19 13
2-7.5	0-3	T6-3	3 1/2 19 12 1/2
7-11	0-15	T9-15	8 3/4 19 13
7-11	0-10	T9-10	7 19 13
7-11	0-5	T9-5	5 1/4 19 13
11-14	0-30	T13-30	15 1/4 19 16
11-14	0-15	T12-15	8 3/4 19 13
11-14	0-10	T12-10	7 19 13
11-14	0-5	T12-5	5 1/4 19 13
11-14	0-3	T12-3	3 1/2 19 12 1/2
14-17	0-15	T16-15	8 3/4 19 13
14-17	0-10	T16-10	7 19 13
14-17	0-5	T16-5	5 1/4 19 13
17-20	0-15	T19-15	8 3/4 19 13
17-20	0-10	T19-10	7 19 13
17-20	0-5	T19-5	5 1/4 19 13
20-23	0-15	T22-15	8 3/4 19 13
20-23	0-10	T22-10	7 19 13
20-23	0-5	T22-5	5 1/4 19 13
22.5-27	0-30	T25-30	15 1/4 19 16
22.5-27	0-12	T25-12	8 3/4 19 13
22.5-27	0-10	T25-10	7 19 13
22.5-27	0-5	T25-5	5 1/4 19 13
22.5-27	0-3	T25-3	3 1/2 19 12 1/2
25-31	0-30	T28-30	15 1/4 19 16
25-31	0-12	T28-12	8 3/4 19 13
25-31	0-10	T28-10	7 19 13
25-31	0-5	T28-5	5 1/4 19 13
25-31	0-3	T28-3	3 1/2 19 12 1/2
31-33.5	0-30	T32-30	15 1/4 19 16
31-33.5	0-12	T32-12	8 3/4 19 13
31-33.5	0-10	T32-10	7 19 13
31-33.5	0-5	T32-5	5 1/4 19 13
31-33.5	0-3	T32-3	3 1/2 19 12 1/2
33.5-36	0-30	T35-30	15 1/4 19 16
33.5-36	0-12	T35-12	8 3/4 19 13
33.5-36	0-10	T35-10	7 19 13
33.5-36	0-5	T35-5	5 1/4 19 13
33.5-36	0-3	T35-3	3 1/2 19 12 1/2

ALL NARROW RANGE MODELS ARE PROGRAMMABLE.

CIRCLE 12 ON READER-SERVICE CARD

The Few Engineers Who Don't Know About C.I.C. Film Pots Might Solve "Short-Life" Pot Problems THIS Way...



Send for large scale reproduction of this unique system.

Wire-wound pot (A) in analog computer wears down. Vibration of X-Y Recorder Pen, trying to follow resultant noise jiggles, creates erratic pattern (B). Mountain goat (C) thinks pattern looks like old mountain homestead, leaps on platform (D) in attempt to reach home. Platform mounted on coil spring bounces, causes string (E) to pull back on pulleys (F and G). String turns spring-action faucet (H) which releases gin (I). Gin pours into vermouth vat (J) automatically mixing 8 to 1 Martini (how dry can you get?) raising level which forces excess to flow into mouth of happily reclining organ-grinder (K). Martini mixture's potency causes grinder's toes to curl, thereby setting organ (L) into operation. Conditioned monkey (M) hears music, proceeds to

dance, impelling bystander (N) to toss coin into monkey's tin cup (O). Rubber bottom of tin cup bounces coin into funnel-tube (P). Coin is carried through tube to automated Wire-Wound Pot Vending Machine (Q) and releases new wire-wound pot, which rolls into position on miniature railroad tracks (see cutaway of computer—R) and bounces worn-out wire-wound pot into container (S). X-Y Recorder resumes normal pattern, goat (tethered with old inner tube—T), jumps off platform, starts feeding on worn-out pots, while waiting for new pot to wear down—which can happen before you can mumble "potentiometer" backwards.

BUT THE BEST WAY YET...

**Use C.I.C. Precision Conductive Film Potentiometers
For Proven* Multi-Million Cycle Life!**

***Ask us for list of missiles and aircraft currently using C.I.C. Film Potentiometers.**

COMPUTER INSTRUMENTS CORPORATION
92 MADISON AVENUE • HEMPSTEAD, L.I., NEW YORK

CIRCLE 13 ON READER-SERVICE CARD

...and Here Are a Few Additional Features:



- INFINITE RESOLUTION
- INHERENT RELIABILITY
- PRECISION LINEARITY
- LOW OPERATIONAL NOISE
- VIDEO FREQUENCY OPERATION

FIRST IN FILM POTS



New All-Plastic

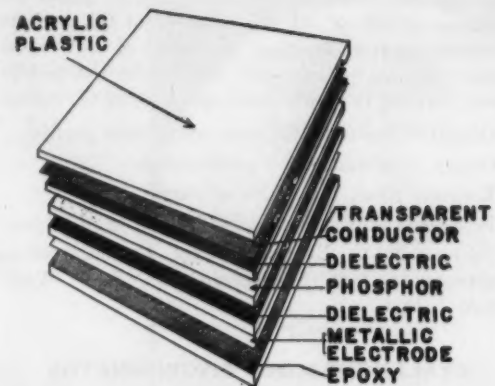


FIG. 1. CUT-AWAY drawing of Astromatic Division EL Type Electroluminescent panel.

FIG. 2. TYPICAL BRIGHTNESS vs. voltage at different standard frequencies for green EL panel.

A new method of applying a transparent conductive coat of stannic oxide on plastic, developed by the engineers of the Astromatic Division, Controls Company of America, has resulted in a two-fold improvement in light output previously obtained from electroluminescent panels.

The electroluminescent principle, briefly stated, is that excitation of electrons within a phosphor to a higher state of energy causes emission of light when the electron is in motion to and from its normal energy level. Research has discovered that certain phosphors are most suitable for use in electrostatically activated panels. These phosphors are the basic element in Astrumatic Division EL lamps.

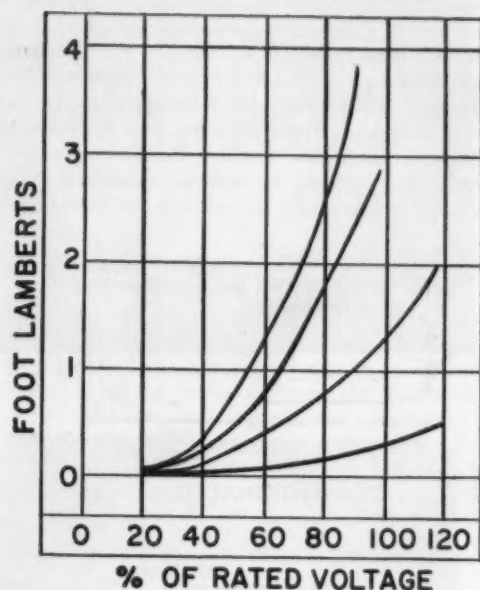
The Astromatic Division EL panel is a multi-layer laminar structure (Fig. 1). The basic support is the transparent plastic (normally a UV military grade acrylic) through which the light is viewed. A transparent conductor which acts as an electrode is applied to this basic acrylic. On this conductive layer the phosphors are applied between dielectric layers. The phosphor, depending on the color of the light desired, is usually a mixture of different monochromatic electroluminescent phosphors. If luminescent phosphors are used in conjunction with electroluminescent phosphors, they are often physically separated.

Over the last dielectric layer a metallic counter electrode is applied. Leads are then attached to the electrode and the counter electrode and the panel is encapsulated in a layer of self-curing type epoxy. The entire EL panel is then completely moisture resistant and is electrically insulated from ground.

Astromatic Division EL panels are available in

MILITARY SYSTEMS DESIGN

Electroluminescent Panel



thickness from 1/16" to 1/4" and in various lengths and widths up to 16" square. Basic colors are green, blue, gold and red, with other colors obtained by overlay filters or phosphor blends.

The light intensity of EL panels is a function

120 volts	60 cycles	400 cycles	1000 cycles
GREEN	.76(.5)	5.12(2.3)	11.62
BLUE	.33	1.42	2.40
GOLD	.35	1.11	1.55
RED	.13	.90	1.77

FIG. 3. RELATIVE BRIGHTNESS of various EL colors at different frequencies. Values are in foot-lamberts.

of both voltage and frequency, as shown by Fig. 2 and Fig. 3. Power consumption of an EL lamp is typically low, a panel of 100 square inches operating at 120 v 400 cps would require less than 10 watts while providing a light intensity of 5.12 ft-lamberts. Also, light failure is not catastrophic in the case of EL panels. There is no abrupt cut-off of light. With passage of time the light gradually diminishes in intensity. Replacement is made when the brightness of the EL lamp is no longer acceptable.

Astromatic Division EL all-plastic panels feature easy machinability, thinness, uniform area lighting, very low power consumption, simplicity of mounting hardware, and "cold" light operation. Typical applications are instrument panels and dashboards, indicator signs, dial illumination, switch plates and direct replacement for all "edgelit" type panels—(From 8-page brochure, "Electroluminescence", Astromatic Division, Controls Company of America, 139 Illinois St., El Segundo, Calif.)

FOR MORE INFORMATION CIRCLE 107 ON READER-SERVICE CARD



TIMING NETWORKS

highly reliable
readily available

TIME DELAY RELAYS (Stock and Custom Designed) Literature Available

Time delay circuitry used in conjunction with the wide selection of rotary balanced armature relays insures you of an infinite variety of time delay relays with basic specifications as follows:

- Time Delay:** 50MS to 3 minutes or more
- Accuracies:** 10% and 5% or better
- Contacts:** Single to 4 pole Form C; more poles where required.
- Temperatures:** -55°C to +85°C or -65°C to +125°C
- Vibration:** 10G or 20G to 2000 CPS
- Shock:** 30G or 50G

***SOLID STATE TIMING MODULES (Custom Designed)**

Designed with no moving parts and to withstand excellent environmental conditions, these modules offer:

1. Wide timing ranges from milliseconds to several minutes.
2. Wide output current handling ranges from milliamps to 50 amperes
3. The ability to switch inductive, motor and other stringent loads.

***SPECIAL ELECTRONIC PACKAGES AND ASSEMBLIES (Custom Designed)**

Combinations of one or more of our various relay series, time-delay relays or solid state switching mechanisms can be used to provide you with:

- Pulse Integrators
- Over & Under Voltage Relays
- Sequence Timers
- Intervalometers
- Stepping Switches
- Phase Detectors
- Close Differential Relays

*Due to the diversity of possible requirements and applications for the last two product categories, we have not been able to prepare general literature. Please send us your individual specifications.

FOR ENGINEERING KNOW-HOW IN RELAY AND SOLID STATE DESIGNS, CONTACT HI-G NOW!

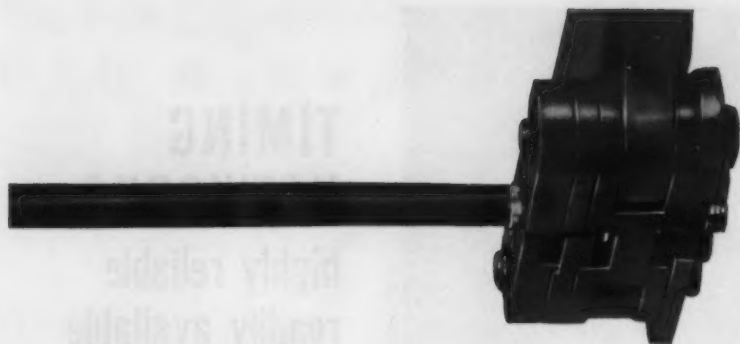


THE ONLY COMPLETE LINE OF BALANCED ROTARY RELAYS

CIRCLE 14 ON READER-SERVICE CARD

HI-G
INC.

BRADLEY FIELD, WINDSOR LOCKS, CONN.



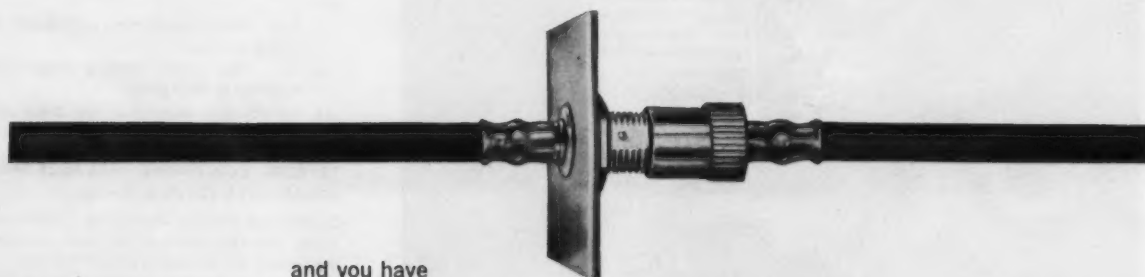
TAKE AMP COAXICON®

the only coaxial cable connector which attaches to both center conductor and outer braid with ONE CRIMP of the matching, precision-controlled crimping tool.



ADD HARDWARE

a lock nut, a lock washer and plug retaining unit.



and you have

AMP COAXICON TNC TYPE

the only threaded nut coaxial connector for through panel installations which can be attached to both inner conductor and outer braid with ONE CRIMP of the matching AMP tool.

RESULT A more than fifty percent saving over other coaxial connector assemblies, even lower installed cost when compared to soldering—plus the extreme reliability created by the AMP solderless termination technique . . . the best in the business! Complete information will be sent on request.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

CIRCLE 15 ON READER-SERVICE CARD

Multi-Mode Storage Tube

A new direct view storage tube providing more versatility in radar, sonar, data processing and TV is capable of: (1) selectively erasing any part of its display, (2) presenting simultaneously stored and non-stored information, and (3) displaying high contrast, high resolution information in either dark or light trace modes. The multi-mode Tonotron tube, an advanced development of techniques used in the original Hughes Tonotron tube, uses a unique dual effects target which employs bombardment-induced conductivity effects as well as secondary electron emission effects found in conventional storage tubes.

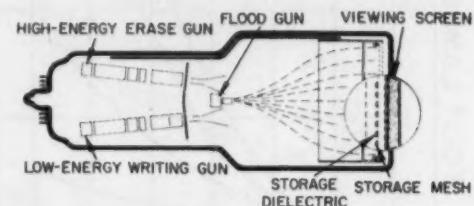


FIG. 1. CONVENTIONAL Direct View Storage Tube Action.

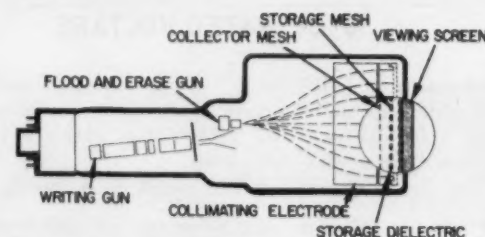


FIG. 2. MULTI-MODE Storage Tube provides simultaneous stored and non-stored presentations plus other versatile modes.

In the Hughes 7222 Tonotron storage tube (Fig. 1) a pulse of electrons from the flood and erase gun charges the storage dielectric grid strongly negative with respect to the flood gun cathode. In this condition, the tube face appears black. As the electron beam from the writing gun bombards this dielectric, secondary electrons leave the storage surface, charging it in a positive direction and creating areas in which the collimated electrons streaming from the flood gun can penetrate the storage surface and excite the view screen phosphor to form the display. A pulse train applied to the erase and flood gun again restores the storage surface to its negative potential, making it opaque to flood gun electrons.

In the multi-mode tube (Fig. 2) secondary electron emission effects provide conventional displays when written by a relatively low energy writing beam. Erasure, however, is accomplished by using relatively high "erase" beam bombardment which causes the target's dielectric to become conductive. While secondary emission still exists, the bombardment-induced conductivity through the dielectric material overwhelms this secondary emission. Charges stored

MILITARY SYSTEMS DESIGN

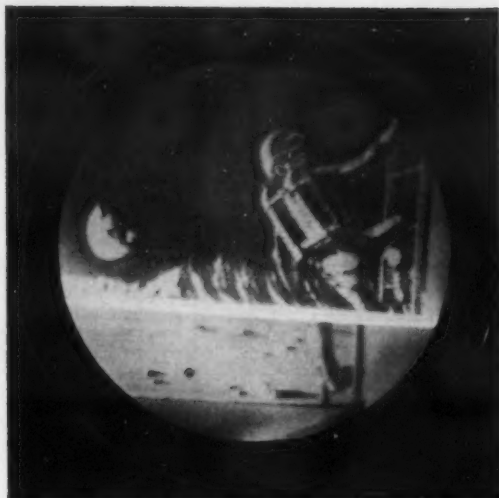


FIG. 3. BRIGHT horizontal line is erasure zone. Old information appears below with new picture above erasure line.

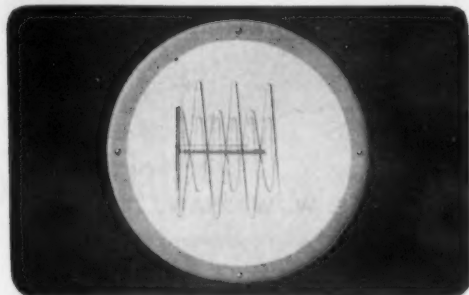


FIG. 4. HIGH Resolution Dark Trace mode with moving cursor super-imposed.

on the dielectric surface are thus discharged to the backing electrode, causing erasure of those portions of the display so affected. At an intermediate beam energy level, writing and erasing effects cancel, enabling the presentation of non-stored and stored information without disturbing the latter.

The capability of the tube to erase selectively enables erasure in a narrow band immediately preceding the scan while allowing the stored information to be maintained at full brightness over most of the display (Fig. 3). In the case of moving information, selective erasure eliminates the effects of smearing caused by successively stored images.

Simultaneous presentation of stored and non-stored information enables super position of cursors, target markers, or maps over stored displays.

High resolution dark trace displays of line or half-tone images can be provided by using the low energy gun to scan the entire storage surface, and the fine beamed erase gun as a writing gun. This produces a high contrast, black-on-white display (Fig. 4) which can be varied in intensity by modulating the erase gun grid. If the dark image is undesirable, the display tones may be reversed by inverting the signals to the erase gun grid. (From 4-page brochure, "Hughes Multi-Mode Tonotron," Vacuum Tube Products Div., Hughes Aircraft Co., 2020 Short St., Oceanside, Calif.)

FOR MORE INFORMATION CIRCLE 108 ON READER-SERVICE CARD

BREAK THROUGH

in automatic logic circuit testing

Production of packaged module circuits gains new impetus with this major achievement! Now you can automatically test the operating characteristics of logic circuit modules, memory boards, component cards and similar units—with speed, precision and dependability.

The new Tape Programmed DIT-MCO Model 720 rapidly performs static and dynamic tests on active and passive modular circuits.

Tests that can be performed with the new Model 720 include:

- Logic circuit response to all logical combinations of DC input levels.
- Marginal tests to evaluate logic modules under conditions of lowered or raised supply levels in combination with lowered or raised signal input levels.
- Complete tests of conversion matrices for proper logic, levels.

The Tape Programmed DIT-MCO Model 720 will accurately test variables which are required to maintain $\pm 0.5\%$ accuracy, and 3 digit tolerance values can be programmed. Provision is made for programming AC or DC sources and external signals through the tester.

Performance of this entirely new circuit analyzer is backed by the experience and reliability of DIT-MCO, Inc.—the nation's leader in automatic circuit testing.

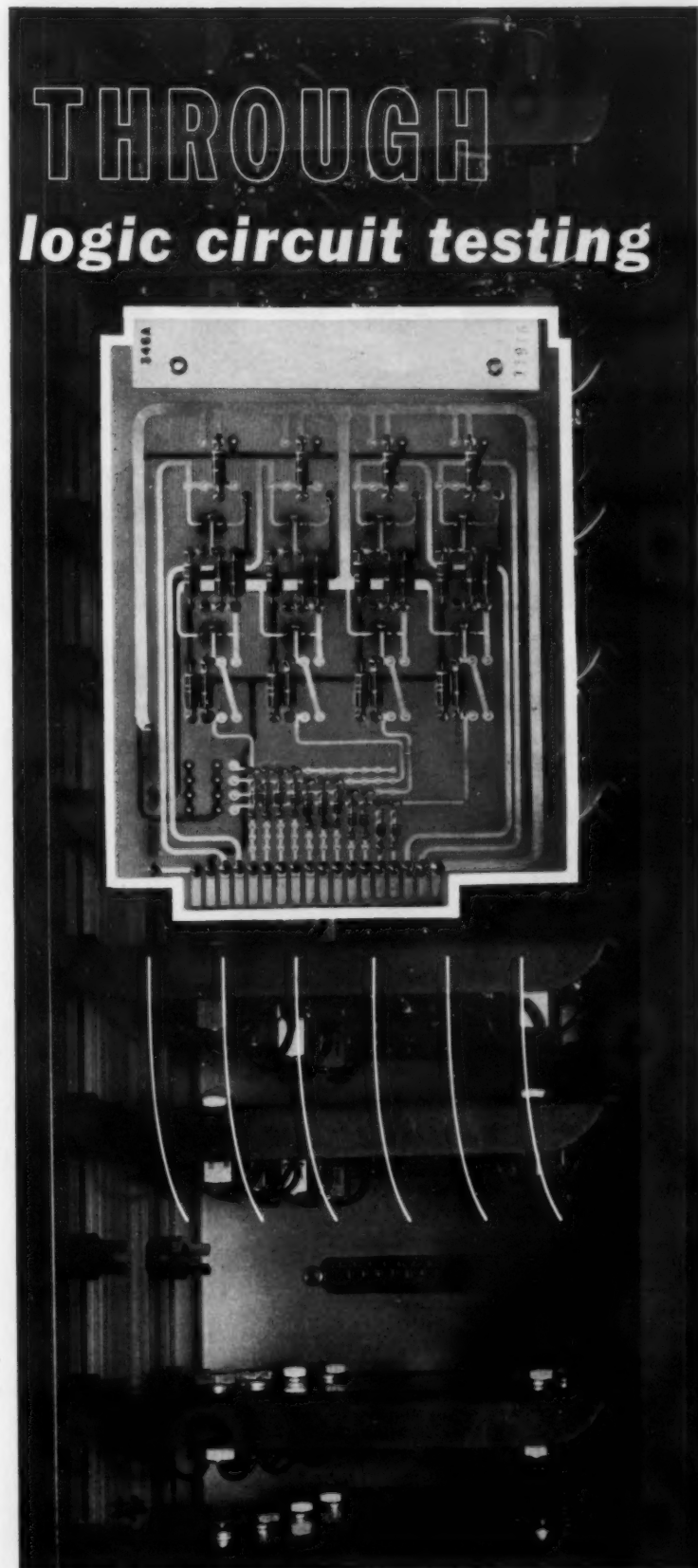
Automatically *you*vers



DIT-MCO, INC.
Kansas City 5, Missouri

911 BROADWAY
HARRISON 1-0011

Denver Area	•	AComa 2-1202
Los Angeles Area	•	ORegon 8-6106
New York City Area	•	MUrray Hill 2-5844
Palo Alto Area	•	DAvenport 5-0180
Seattle Area	•	MAin 4-3780



CIRCLE 16 ON READER-SERVICE CARD

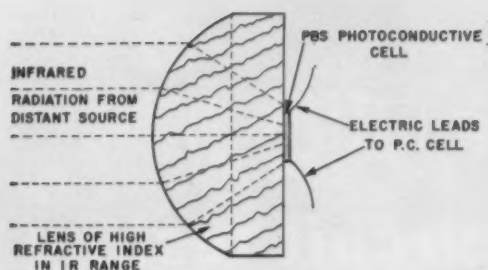
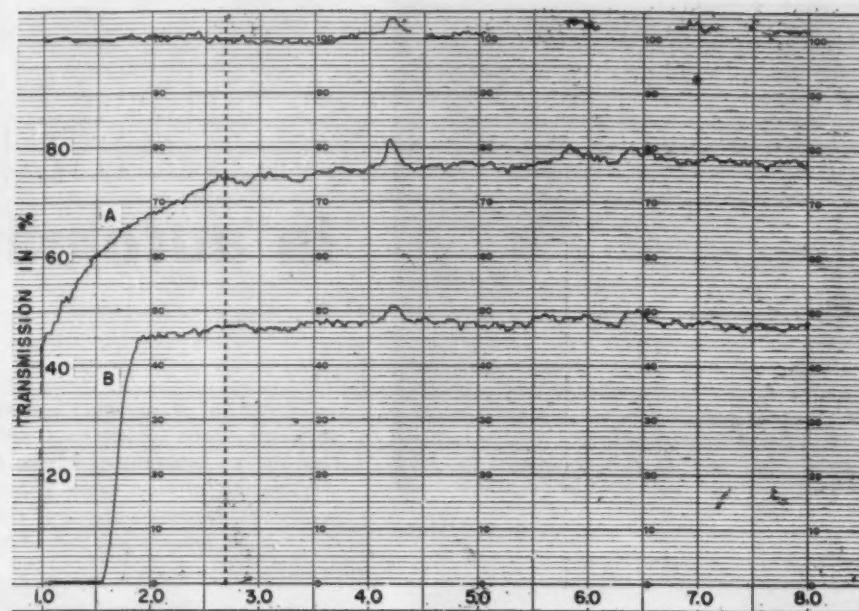


FIG. 1. IMMERSSED DETECTOR, Typical Schematic.

FIG. 2. TRANSMISSION properties of Irtran (A) and germanium (B) optical materials in the infrared spectrum are compared. The important 2.7 micron monochromatic infrared window is located by the dotted vertical line. Curve (C) is the 100% trace made by a third equivalent sensor with no transmitting medium interposed.



The Immersed Lead-Sulfide Detector

E. W. WARSAW, JR.
Infrared Industries, Inc.

INFRARED detecting devices and systems are rapidly increasing in importance as working tools of industry and the military. One basic element of this technology is the photoconductive cell. These cells absorb photon energy from infrared radiation to produce a change in their resistance or conductivity independent of any heating effect. Among the materials classified as infrared-responsive photoconductors are a number of metallic sulfides, tellurides, and selenides as well as germanium, silicon, and the intermetallic elements. The most extensive development in this group has been done on lead sulfide (PbS) because of its high sensitivity, short time constant, wide wavelength response, low noise, relatively low impedance, and, in particular, its adaptability to production techniques.

Applications of infrared detection systems have progressed at an accelerated rate during the past decade. The first detectors, used to indicate the presence of fire, are rather crude when compared with today's systems for detecting the exhaust gases of a missile or in pinpointing its hot nose cone as it re-enters the earth's atmosphere. The successful growth of this expanding industry is due to constant improvements in IR detectors. Immersed PbS detectors are a major contributor in this technological advance.

Photoconductive detectors can be made in several

basic configurations. The immersed optics detector is favored in critical applications where optical gain and/or increased angular coverage is required without loss of sensitivity. In constructing such a detector, lead sulfide is chemically deposited on the plano surface of a plano-convex lens (Fig. 1). The material used for the lens is a high-refractive-index substrate such as sapphire, strontium titanate, rutile or silicon, each of which has superior optical qualities, as well as being compatible with lead sulfide.

Recently a new series of high-index materials, known as "Irtran", was developed by Eastman Kodak. This new material, although having a lower index of refraction than some of the materials previously mentioned, does not require expensive grinding during manufacture. Quantities of Irtran lenses can be simultaneously and accurately molded.

Why Use Immersed Detectors?

Experience shows that the over-all gain in immersed detector sensitivity is approximately equal to the refractive index of the optical material. This gain is derived from the ability of the lens to concentrate incident radiation on a smaller detector-sensitive area. The feasibility has been established of immersing detectors on silicon with a refractive index of 3.4, sapphire with 1.7, strontium titanate with 2.23, rutile with 2.3, and Irtran with an index

of 2.3.

The availability of Irtran points to the economic feasibility of large optic single lens designs. The manifold advantages of the single lens design can be summed as:

- Optical and electrical efficiency of the system is enhanced because the single lens configuration eliminates the air-transmission path and one transmission media boundary inherent in a two-lens design.
- Material economies are effected in the single lens system—1) the cost of producing the auxiliary condensing lens of a two lens system is eliminated; 2) savings in the much-simplified mounting hardware and 3) anti-reflective coatings are required on only a single surface.

A major problem in immersing PbS on some of the substrates was that of electrically insulating the substrate materials from the PbS film. Infrared Industries, Inc., in their Waltham, Mass. plant has demonstrated several optically suitable materials which electrically insulate the PbS from these troublesome lens materials, serving a dual purpose of electric insulation and of optically matching materials of different refractive indices.

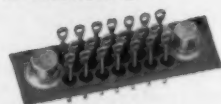
FOR MORE INFORMATION CIRCLE 109 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

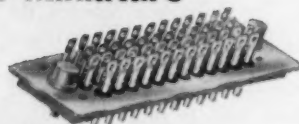
Now
Design
from a
Complete
Standard
Line!



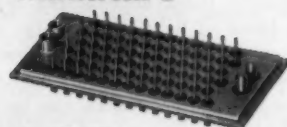
Hermetic
Micro-Miniature



Sub-Miniature



and Miniature



Connectors

With hermetic connectors for every purpose, ESCON simplifies your design problems. Eliminate costly, time-wasting "specials". ESCON connectors offer 4 to 75 contacts, a variety of physical dimensions, meet or exceed MIL specs. New Micro-Miniatures are the ultimate in space and weight savings. If you need a "special", ESCON's creative engineers and ultra-modern facilities can design and produce... fast. What are your requirements?

FREE SAMPLE

Inspect ESCON quality... ask for free sample of typical ESCON connector. ESCON, INC., 731 Branch Ave., Providence 4, R. I. A Subsidiary of Glass-Tite Industries, Inc.



CIRCLE 17 ON READER-SERVICE CARD

May-June, 1961

Ultra Stable Oscillator

The Hermes Model 101C Ultra Stable 1 Mc Oscillator has a guaranteed frequency stability of 5 parts in 10^{10} /day. This guaranteed stability is commonly exceeded by a generous margin, several users indicating that average drift rates of less than 1 part in 10^{10} /day are numerous and that average drift rates of as low as 1 part in 10^{10} /week have been observed.

The crystal of the Ultra Stable Oscillator is a con-



FIG. 1. ULTRA STABLE 1 mc Oscillator Block diagram.

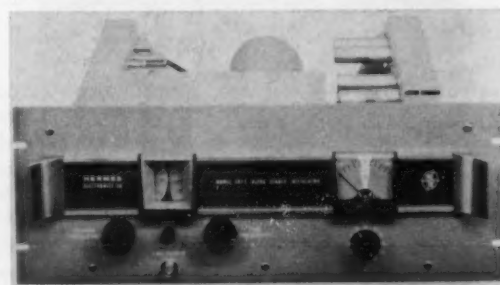


FIG. 2. STABLE FREQUENCY STANDARD for scientific establishments and missile range timing is available in the Model 101C Oscillator.

toured AT cut quartz crystal plate operating in its fundamental thickness shear mode with a Q in excess of one million. The power dissipated in the crystal is stabilized at a level of approximately 0.1 microwatt. Variations in dissipation are held within $\pm 10\%$ by the delayed AGC circuit which follows the oscillator (Fig. 1).

The crystal is permanently housed in an oven whose primary insulation is a dewar flask mounted in a suitable enclosure. The oven operates at a temperature in the range of 55° to 65°C which is adjusted to a value at which the particular crystal exhibits its zero temperature coefficient. Variations in the oven temperature are maintained within 0.01°C of this value by the heater control circuitry.

A test switch on the front panel of the Ultra Stable Oscillator (Fig. 2) enables the reading of eleven different test points in the oscillator circuit on the microammeter dial. The coarse frequency dial control permits adjustment of oscillator frequency over a range of ± 0.5 cps in steps of 0.1 cps; while the fine frequency control is calibrated in parts in 10^9 .

Outputs are sine wave at 2.5 v rms, with output impedance of approximately 250 ohms available on front and back of chassis. A pulse output of approximately 1 volt peak is also available. Power requirements are ± 150 v dc regulated, at 100 ma during warmup and 60 ma normal, and 6.3 v ac or dc at 3 amps. (From 4-page technical Bulletin USO, Hermes Electronic Co., 75 Cambridge Pkwy, Cambridge 42, Mass.)

FOR MORE INFORMATION CIRCLE 110 ON READER-SERVICE CARD

GAIN MORE GAIN with Statham's new SA9-0 DC to DC Signal Amplifier



Here's a major advance in DC signal amplifier design that gives you the HIGHEST GAIN available today—combined with a wider temperature range, a smaller sized package, and unequalled stability! The new versatile SA9-0 provides complete utilization of low-level DC signals from thermocouples, thermal sensing to bridges and DC excited transducers, etc. It gives you the utmost in dependability under extreme environmental conditions. Modular construction makes the compact transistorized SA9-0 ideal for airborne applications requiring multiple channel installation in limited space. Write for complete technical data!

GAIN: Continuously variable from 50 to 500. (Special models up to 1000)

TEMPERATURE RANGE

OPERATING: $-65^\circ\text{F. to } +165^\circ\text{F.}$

NON-OPERATING: $-65^\circ\text{F. to } +225^\circ\text{F.}$

THERMAL COEFFICIENT

OF SENSITIVITY: $0.02\% / ^\circ\text{F.}$

THERMAL ZERO SHIFT: $0.01\% / ^\circ\text{F. of full scale output.}$

OUTPUT: 0 to 5 V DC

INPUT REQUIREMENTS: 0 to 5 mv DC.

POWER REQUIREMENTS: 30 ma at 28 V DC $\pm 10\%$.

WEIGHT: 8 oz. (approx.)

SIZE: less than 8 cu. in.



ELECTRONICS
ED
DIVISION

Statham Instruments, Inc., 12401 W. Olympic Blvd.
Los Angeles 64, Calif. / GRanite 8-0361 / TWX: West Los Angeles CAL 6602

CIRCLE 16 ON READER-SERVICE CARD

Control Applications for Silicon Solar Cells

BY RICHARD L. MOLAY, Semiconductor Div., Hoffman Electronics Corp.

IN 1955, a team of researchers working on silicon transistors at the Bell Telephone Laboratories discovered that a silicon crystal with a p-n junction will generate an electric current when it is exposed to light. Subsequent investigation uncovered improved configurations for such a device, and suggested that an energy conversion figure of about 6% seemed obtainable.

The correct name for the reaction is photovoltaic energy conversion. Using the quantum-mechanical theory of light, the total number of photons striking a surface can be computed, their basic energy content calculated, and the resultant electrical energy output from the converter cell can be evaluated. The exact manner in which the conversion takes place is beyond the scope of this article, but has been well defined by several authors.

After refining the theory of silicon photovoltaic energy conversion, Bell Laboratories licensed a division of Hoffman Electronics Corporation to produce them in commercial quantities. During the course of research and development, Hoffman scientists discovered methods of raising the electrical output, and developed configurations which are now common to users of silicon solar cells. At the date of this writing, cells with a conversion efficiency of 15% are available.

An interesting comparison can be drawn between the silicon conversion of sunlight to electrical energy and one other system: Perhaps a billion years ago, sunlight nourished the growing plants of that era, and made them prosper. Eons of interment in the ground, and the processes of decay, compaction, etc., transformed these plants into coal. Today, a man digs the coal, and burns it to create heat. The heat, in turn, is transferred to a vessel of water, which is converted into steam. The steam is forced through the vanes of a turbine which rotates an electric generator armature, which, in turn, is forced through the magnetic lines of force surrounding it. Finally, an electric current is produced. The final percentage of primordial sunlight energy which shows up as useful electricity is probably considerably less than 15%.

Photovoltaic Control

Aim a beam of light onto the surface of a silicon solar cell, and an electric current is generated. Turn off the light, and the current ceases flowing. It is the very simplicity of this basic idea which makes it so useful to the systems design engineer; for as systems get more complicated, their parts must become more reliable and fail-safe if they are to succeed. The purpose of this paper is to suggest new techniques of control design to the person who may be unfamiliar with the solar cell.

The ability of the silicon solar cell to produce useful quantities of electrical energy has commanded the most attention from the public. A satellite in orbit which speaks with a radio voice powered by solar cells is romantic and dramatic. However, let us consider for a moment, the usefulness of a device which generates only a small electrical output.

The micro miniature EA7 Detector Capsule is a tiny solar cell hermetically sealed in a glass bulb. The external dimensions of the bulb are 0.500 inches (max.) in length, and .080 inches in diameter. Truly a tiny generator! But when it is illuminated by a 1250 footcandle source at a color temperature of 2800K, it yields 300 microamps of current at about 0.34 volts. Working into a 1,000 ohm load, this output can be amplified by any conventional method.

Now let us go back to our basic idea. If the detector capsule is installed behind a door which can cover and uncover a light source, it will tell when the door is open or shut—and it does this without any bias supply or other power input. Open and close the door at a high frequency, and the detector will still function dependably, because its response time is less than 10 microseconds. So far, simple on-off states are possible, but we have not utilized the science of optics. Because light itself is a part of the control system, we can use optical principles to add new dimensions in control.

For example, by covering the cell with a polarized filter, it can become very discriminating as to what it will or will not "see." By placing color filters over the cell, it becomes even more selective.

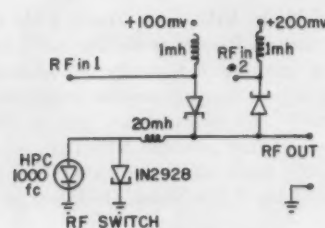


FIG. 1. LIGHT-OPERATED RF Switch. Two RF signal inputs are individually switched to the output.

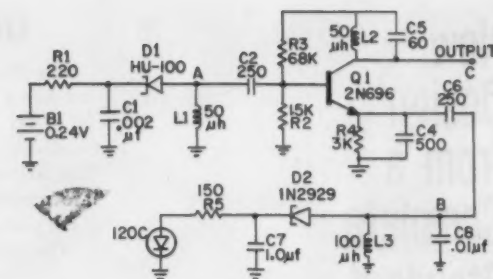


FIG. 2. LIGHT-OPERATED MODULATOR. A number of different semiconductor devices, including a unitunnel diode, a transistor amplifier modulator, a tunnel diode audio oscillator and a 120C photoelectric cell form this circuit.

Another optical effect is enhanced by using vernier filters. A radially-shuttered filter in line with a vernier-scaled shutter can admit a light pattern which exactly corresponds with the rotational coincidence of the filters. This principle has been employed by several firms in building shaft-position encoders.

At least one firm has fabricated a device which uses sharply focused light shining into the blunt end of a chisel-shaped prism. The difference between the refractive index of the prism and that of the surrounding air is sufficiently large to confine the beam to the prism. The light reflects from the two sides of the chisel point and comes back to the base end, where it is picked up by a solar cell and translated into an electrical current. But if the prism is surrounded by a liquid with a refractive index approaching that of the prism itself, the beam of light will not stay within the prism . . . it travels out into the liquid and for all practical purposes is lost. This principle has led to the development of a liquid sensor which can be used under extremely adverse conditions and is not subject to sudden failures.

Silicon solar cells can "see" a limited portion of the infrared spectrum. They do not operate as well at those frequencies as they do under ordinary sunlight, but they can detect infrared rays which are invisible to the human eye. Since the electrical output is somewhat dependent upon the frequency of the light source, these solar cells can be used as heat sensors in specialized applications where there is an associated color change. One natural application might be in a steel rolling mill, where the stock is hot enough to emit light which changes in frequency as it changes temperature.

In the field of communication, the silicon solar cell responds quickly enough to demodulate a coherent light beam. One firm has built a toy solar-talkie. The transmitter is a mirror mounted at the end of the speech-chamber. As the speaker directs his voice into the tube, the mirror vibrates and modulates the sunlight striking its surface. Another tube 30 feet away intercepts this light and directs it to a solar cell. The

electrical output is fed through a transformer into a sensitive earphone, and communication is good.

Applications

With the onset of laser technology, the silicon solar cell should play a larger role in communications.

The open circuit voltage output of a solar cell is a logarithmic function of illumination intensity within certain limits. This useful characteristic suggests many possible applications.

Relays may be operated directly from photovoltaic readout cells. An example is the Barber-Colman "Micropositioner," Type AYLZ7308-100, which will activate at 100, 800 and 3000 footcandles when used with a 120C, HPC or EA-7 cell respectively. A less sensitive relay may be used in conjunction with a transistor amplifier.

Photovoltaic readout devices used for signal switching are shown in one arrangement in Fig. 1. Here a solar cell, a tunnel diode and two uni-tunnel diodes are combined to accomplish RF switching.

Note that the anode of the tunnel diode, cathode of the first uni-tunnel diode and anode of the second uni-tunnel diode are tied together insofar as DC is concerned. Thus, initially when the tunnel diode is in its low voltage state or at zero, the first uni-tunnel diode will conduct because it is forward biased. At this time the second uni-tunnel diode is reversed biased. When the solar cell is light activated, causing the tunnel diode to switch to its high voltage state, the first uni-tunnel diode will be reversed biased and the second will be forward biased. The RF signal connected to the uni-tunnel diode which is forward biased will appear in the output. The RF chokes isolate the RF signals from the tunnel diode and supply voltage source.

The circuit of Figure 2 is of interest in that it applies a number of different semiconductor devices. A uni-tunnel diode generates RF energy which is amplified by a 2N696 transistor amplifier-modulator stage. A 120C photoelectric cell activated by 70 ft candles powers the 1N2929 tunnel diode audio oscillator which is coupled to the emitter of the 2N696. RF signal is at 2.5 mc and modulating frequency is approximately 166 kc.

The foregoing examples are a sampling of the techniques which have been explored. All derive benefit from the inherent qualities of the silicon solar cell.

It will never wear out. Since it uses energy from the sun to impart mobility to electrons in its structure, there is no depletion factor.

The cell will work under a wide temperature range, (minus 65 degrees centigrade and plus 175 degrees C.). The cell works better as it gets cooler.

CIRCLE 405 ON READER-SERVICE CARD



Progress In Hydrogen Thyratrons

55 x 10⁹

ANODE DISSIPATION FACTOR



G-E Power Tube Department Products Also Include:

- Ignitrons
- Traveling-wave tubes
- Magnetrons
- Metal-ceramic tetrodes
- High-power duplexers
- High-power waveguide filters
- Klystrons
- Thermionic converters

Highest Registered Rating Now Available from G.E. In an Air-cooled Tube

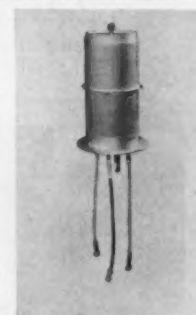
The latest addition to General Electric's expanding line of hydrogen thyratrons is now available for pulse applications such as radar modulators and linear accelerators. Developed under U. S. Army Signal Corps contract, the GL-7890 achieves an anode dissipation factor of 55×10^9 and has a peak anode voltage rating of 40 kv. The tube can now be operated water-cooled or air-cooled at full ratings.

COMING: INCREASED CURRENT AND VOLTAGE CAPACITY

Now in the late stages of development, the Z-5212 will further increase voltage and current-carrying capacity in hydrogen thyratrons. Peak anode voltage rating for this tube will be 50 kv with an average current rating of 8 amp. General Electric's Power Tube Department will welcome your requests for technical data on the Z-5212.

TEMPERATURE INDICATING DEVICE ON GL-7390A

The first high-power ceramic-metal hydrogen thyatron, General Electric's GL-7390, is now being built to MIL specifications. A modified version of this tube, the GL-7390A, is equipped with an integral anode temperature indicator for convenient readings. Both the GL-7390 and the GL-7390A have ratings of 33-kv peak anode voltage and 4-amp average current.



GL-7390A

HYDROGEN THYRATRON BULLETIN AVAILABLE

For a comprehensive analysis of the theory and application of hydrogen thyratrons, write to the Power Tube Department, General Electric Company, Schenectady, N. Y. Ask for Bulletin PT-49. To order, or obtain more information on hydrogen thyratrons, contact your nearest Power Tube sales office. Phone numbers are listed below.

265-09-9545-8481-36

POWER TUBE DEPARTMENT

GENERAL ELECTRIC

TELEPHONE TODAY—Syracuse, OL 2-5102 ... Clifton, N. J., GR 3-6387
... New York City, WI 7-4065 ... Washington, D. C., EX 3-3600 ... Chicago, SP 7-1600 ... Dayton, BA 3-7151 ... Orlando, Fla., GA 4-6280 ...
Los Angeles, GR 8-7765.

CIRCLE 19 ON READER-SERVICE CARD

Infrared Sensors Stabilize Spacecraft

In his flight through space in the Mercury Manned Spacecraft, the astronaut makes observations through a periscope pointed downward at the earth. A means

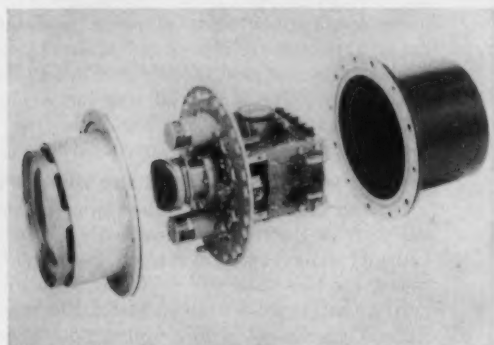


FIG. 1. INFRARED HORIZON SENSOR for Mercury Spacecraft. Two such sensors are used in each Mercury spacecraft to periodically correct the inertial platform in order to maintain local vertical to the earth's surface.

for keeping the spacecraft horizontal with respect to the earth is required to prevent any rolling or pitching motion of the vehicle which would shift the periscope's field of view and might also inter-

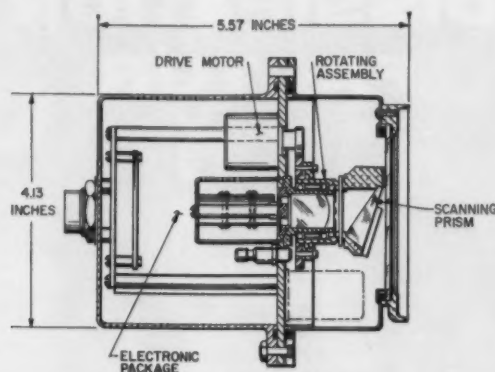


FIG. 2. CROSS-SECTION of Rotating Prism Scan Horizon Sensor. Thermistor element is immersed in rear surface of germanium lens.

fere with the astronaut's performance of his other duties.

Two infrared horizon sensors are positioned at right angles to each other in the spacecraft; one for sensing pitch errors, the other for roll errors (Fig. 1). These sensors continuously scan earth and space to detect the "thermal horizon" between the nearly absolute zero of outer space and the warmth of the earth's troposphere. This horizon is the best available stable reference for establishing a vertical to the earth below, affording accuracies of better than $\pm 1^\circ$ from the true local vertical. Using this reference, the sensors generate electrical signals which are used to periodically correct the inertial platform which is the primary stabilizing element in the Mercury Spacecraft. Each sensor contains a detector for converting received infrared radiation to an electrical signal, a rotating prism for scanning the detector across earth and space, and a transistorized electronics system for processing the detector's electrical output signal and converting it to the form of pitch and roll correcting signals, in a package $5\frac{1}{2}$ " long x $5\frac{1}{2}$ " diameter, including mounting flange.

The technique of infrared horizon sensing was developed by Barnes Engineering Company of Stamford, Conn., as part of their space vehicle instrumentation program. The Company is now manufacturing infrared horizon sensors under subcontract to McDonnell Aircraft Corporation, NASA's prime contractor for the development and manufacture of the Mercury Spacecraft.

Construction details are shown in Fig. 2. The infrared detector is mounted at the center of the circular plate. The active element is a flake of thermistor material immersed in the rear surface of the germanium lens. Germanium is an ideal material for this purpose because its high index of refraction permits the fabrication of a "fast" lens without excessive curvature. Also, its spectral bandpass of from 1.8 to 20 microns effectively filters out nearly all solar radiation and makes the sensor insensitive to possible disturbances from cloud edges and surface features. In the horizon sensor, the lens focuses incoming radiation upon the active thermistor flake and increases its detectivity to almost four times higher than that of an equivalent unimmersed detector.

The detector has a 2° by 8° field of view which extends through the circular opening in the center of the scanning assembly. The scanning prism deflects the detector's line of sight 55° away from the normal. As the prism is rotated by the drive motor and associated gears, the detector field sweeps through a hollow-cone-shaped volume of space having an apex angle of 110° .

During the major portion of each scan, the detector's field of view is passing over the cold of



TABER TELEFLIGHT® 179
The Tiny New PRESSURE TRANSDUCER
that goes along with the BIRD!

Space is at a premium . . . accurate pressure measurements of 0.25% are required over a wide temperature range. The answer is Taber's tiny reliable TELEFLIGHT, the miniature transducer with Bonded Strain Gage construction that has extremely low sensitivity to vibration and shock. When the Teleflight is subjected to zero gravity conditions (as in space flight where convection cooling is non-existent) the Ni-Span proving ring acts as a heat sink and conducts heat AWAY from the resistance gages to the instrument case. Measures corrosive gas and liquid pressure including fuming NITRIC ACID. With factory modifications will handle Fluorine. 200% overload protection built in at no extra cost. Taber Indicators or standard make recorders can be used as read out instruments. Infinite resolution, Linearity 0.25%, Hysteresis 0.25%, Temperature -100°F . to $+275^\circ\text{F}$, Repeatability within 0.1%, Pressure Ranges of Model 179 shown 0-50 PSIA or PSIG; pressure ranges up to 10,000 available on other models. Taber also produces a complete line of miniature transistor amplifiers.

Write for illustrated literature.

TABER INSTRUMENT CORPORATION

"Where the Accent is on Accuracy and Reliability"

SECTION 242 107 GOUNDRY ST. NORTH TONAWANDA, N. Y.
 TELEPHONE: NX 3-8900 • TWX-TON 277

Complete line of transistor amplifiers available from stock.

Exclusive feature is pressure cavity that is easy to clean out during ground testing by simply removing 12 screws.

CIRCLE 20 ON READER-SERVICE CARD

[illegible]

edges. These pulses trigger a reference generator, producing a 30-cycle square wave that is phase-locked with the existing position of the spacecraft.

Special features include a centrifugal sun shutter for protecting the detector from the sun for use in long missions in which good stabilization is achieved and in which power conservation can be accomplished by operating the sensors for only brief periods. As long as the scanner is rotating, direct sunlight cannot damage the detector. However, during shutdown, it is possible for the detector to be damaged by exposure to the sun for extensive periods. To prevent possible damage under these conditions, the spring-operated sun shutter closes as soon as rotation stops, but opens again by centrifugal force when scanning is resumed.

FOR MORE INFORMATION CIRCLE 111 ON READER-SERVICE CARD



Radiation is usually associated with high temperatures. Yet very cold bodies emit a radiation which can be highly significant in missile and space applications. The problem faced by infrared scientists, trying to detect variations in radiation from low temperature atmospheres, can be likened to detecting a one-foot cube of ice from a distance of five miles.

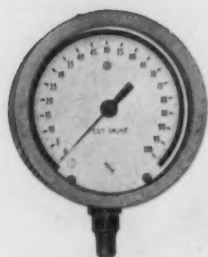
Lockheed Missiles and Space Division scientists are deeply engaged in studying the problems of infrared emission from the earth and its atmosphere, as seen from orbital altitudes. Although the earth resembles a black body at 300° Kelvin, the emission from its atmosphere, under some circumstances, is much colder. To make measurements under these circumstances, Lockheed has evolved radiometric equipment with one of the most sensitive detection systems yet conceived.

Scientists and engineers must also take careful measurements of a potential employer. Lockheed Missiles and Space Division in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, invites this close scrutiny. As Systems Manager for the DISCOVERER and MIDAS satellites and the POLARIS FBM, Lockheed preeminence in Missiles and Space creates positions in many disciplines for outstanding engineers and scientists.

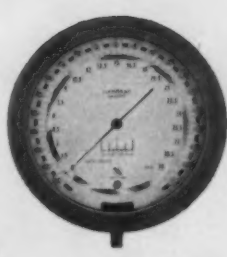
Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-13E, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required. *All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.*

Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS Programs

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII



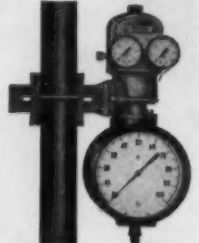
ASHCROFT LABORATORY
TEST GAUGE



ASHCROFT MAXITEST®
MASTER REFERENCE GAUGE



ASHCROFT MAXISAFE®
DURAGAUGE



ASHCROFT PNEUMATIC
TRANSMITTER

PRESSURE GAUGES

that meet the specs of any
aerospace project

Ashcroft Pressure Gauges and Pneumatic Transmitters were the first to be accepted for LOX and other liquid oxidizer applications. They are manufactured in strict compliance with exacting specs for cleanliness. Whether for jet or missile test stand, control center, ground support equipment, laboratory, or any other service, Ashcroft Gauges are tailored to provide the sustained high accuracy and reliability that are indispensable in military and scientific projects.

Ashcroft Gauges were first made for industry in 1850 and have since seen service on land, sea, and in the air. Today Ashcroft pressure indicating instruments include every type from master reference gauges and pocket test gauges to service gauges, pneumatic transmitters, and deadweight gauge testers. Dial sizes range from 2" through 24" and pressures from 30" vacuum or a few ounces to 100,000 psi. Also available are 7 Bourdon tube materials, temperature compensated as required, and rotary geared movements in stainless steel or stainless steel with nylon bearings and pinion gear.



Get complete information about Ashcroft Pressure Gauges, Transmitters, and accessories for your aerospace projects. Write for Catalog 300 B.

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

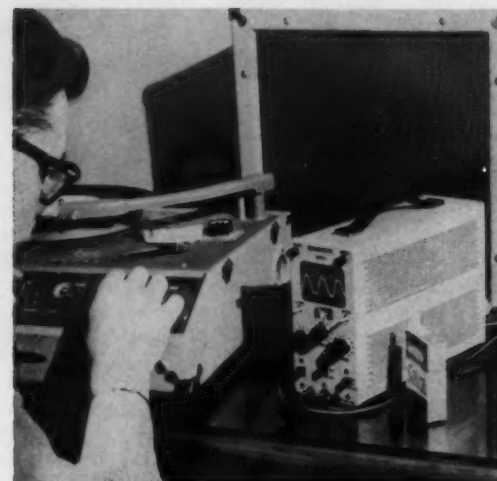
Gauge and Instrument Division • Stratford, Connecticut

Canada: Manning, Maxwell & Moore of Canada, Ltd.,
Galt, Ontario

CIRCLE 21 ON READER-SERVICE CARD



Miniature Oscilloscope



New Miniature Oscilloscope, PRIMER-SCOPE, Mark I, weighs less than six pounds. Main component is a special 3" Rayonic cathode ray tube, incorporating an integral magnetic shield to prevent stray or spurious pickups. Accelerating potential is approximately 840 v. Vertical sensitivities are: 250 mv/division (1/4 inch) in the DC mode and with the AC preamplifier switched in, 6 mv RMS/division.

Response is from DC or 20 cycles to 75,000 cycles. Horizontal sensitivity in RMS millivolts per division is 150. The sweep rate is continuously variable in

three overlapping ranges from 20 cycles to 20,000 cycles.

The time base is very stable with excellent linearity over the entire range. Synchronization voltages are derived either from the vertical amplifier plate circuit or from an external source. Application is aimed at beginners, students, light industrial, service, laboratory use, etc. The PRIMER-SCOPE is a development of the Waterman Products Co., 2445 Emerald St., Phila. 25, Pa.

FOR MORE INFORMATION CIRCLE 112 ON READER-SERVICE CARD

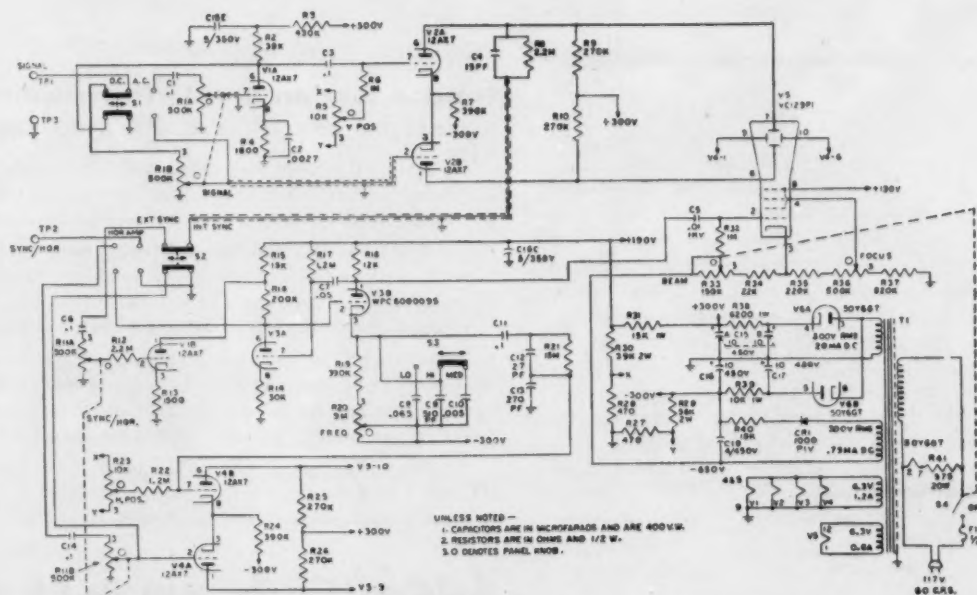


FIG. 1. SCHEMATIC CIRCUIT of miniature Primer-Scope, Mark I.

MILITARY SYSTEMS DESIGN

Modular DC Power Supplies

Power supplies designed for production or prototype use are readily adapted for packaging in the customer's equipment. For the laboratory different module groupings can be quickly assembled or disassembled in one of Dressen-Barnes RACK Mounting kits (Fig. 1).

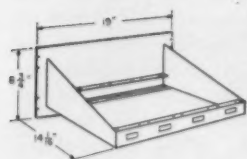


FIG. 1. RACK Mounting Kits enable quick assembly of laboratory power supplies.

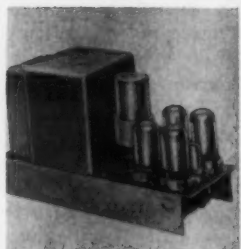


FIG. 2. MODULAR SUPPLY Model 22-107 is typical of MIL-Spec Type Supply.

Many government contractors do not require full MIL-Spec treatment, but the supplier may prefer to provide the increased reliability associated with components of the MIL-Spec type. To meet this demand, Dressen-Barnes has developed a good selection of modules with hermetically-sealed transformers and MIL-Spec type components. Type 22-107 (Fig. 2) is typical of this group, which are all provided with a pot for output voltage adjustment, 105-125 vac input and a 6.3 v ac unregulated output. Other characteristics which apply to the type 22-107 are: (1) dc output adjustable to any point in the 225-425 v range, 0-0.150 amps; vacuum-tube regulated output holds within 0.05% for line fluctuations from 105 to 125v and for load fluctuations from no-load to full-load with line voltage held at 115v; maximum ripple is 3 mv at 115v line voltage . . . (From 24-page DC Power Supply Designers' Handbook and Catalog, Dressen-Barnes Electronics Corp., 250 Vinedo Ave., Pasadena, Calif.)

CIRCLE 113 ON READER-SERVICE CARD

CIRCLE 22 ON READER-SERVICE CARD →

$$T_m = g, Q_r$$

$$\mu_c^2 = \mu_g$$

$$\alpha/m \times 2$$

$$V = \frac{P}{(1+r)^n}$$

$$\frac{E_{in(min)}}{I_L(max)}$$

$$D = kV^2$$

**The LGP-30
Electronic Computer
is designed to stop
the juggling of figures
—and start the
creating of profits.**

The Royal Precision LGP-30 can solve routine and theoretical mathematical problems 30 times faster than any man—yet rents for little more than the salary of an additional engineer.

It is simple to program and operate, so no special programmer is needed.

An engineer can use it himself.

It requires no air-conditioning or costly installation. It plugs into any 110-volt AC wall outlet. It is mobile, so it rolls anywhere.

It is desk-size, so it requires little room.

This means that the Royal Precision LGP-30 is ready to go to work to help your company create new products—and fresh profits—the very same day it is delivered. Can you wonder that there are more LGP-30's installed and working right this minute than any other electronic computing system in its class?

For more information: write
Floyd Ritchie, Royal McBee Corporation,
Port Chester, New York.

ROYAL **GENERAL**
McBEE **PRECISION**

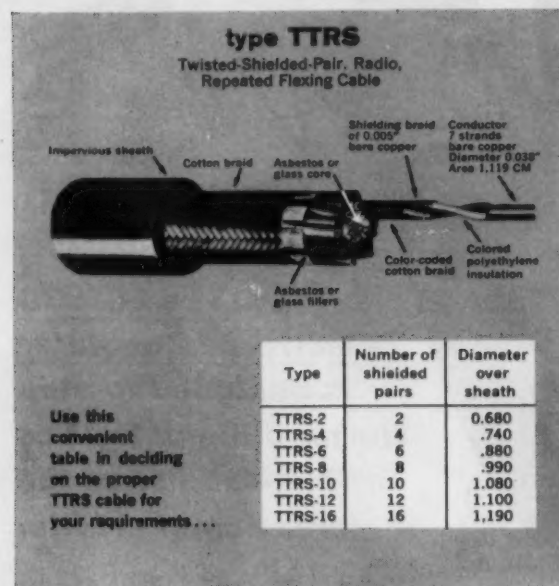
ELECTRONIC DATA PROCESSING SYSTEMS

© 1961 ROYAL MCBEE CORPORATION

TTRS:

in cable language, the most sought-after four-letter word for military systems

Of the various cables available for military systems, the one in biggest demand is type TTRS and its armored companion, TTRSA. Made to military specification. (MIL-C-915A, Amendment 8), its versatility is such that it is used in the ground support equipment of practically every major missile and rocket project. Type TTRSA is made with a Mylar wrap over the shielding; TTRS is made without the basket weave armour or Mylar wrap. The following is a detailed breakdown of the specifications:



To meet the urgent demand and cut lead-time, Normandy Electric Wire always has large pre-inspected stocks of TTRS and TTRSA on hand for immediate delivery. This is one of many reasons why so many firms have made Normandy their #1 source for hard to find, heavy duty shielded cable. For some of the other reasons, send for NORMANDY'S FREE CATALOG!

NORMANDY
ELECTRIC WIRE CORP.

125 Second Street, Brooklyn 31, N. Y. • TRIangle 5-9863
CABLE ADDRESS NORMWIRE, NEWYORK

CIRCLE 23 ON READER-SERVICE CARD

Circular Bi-Polarized Array for NASA-Wallops

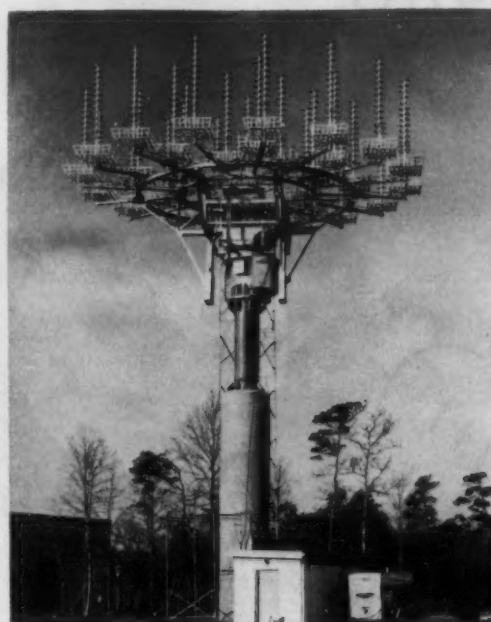
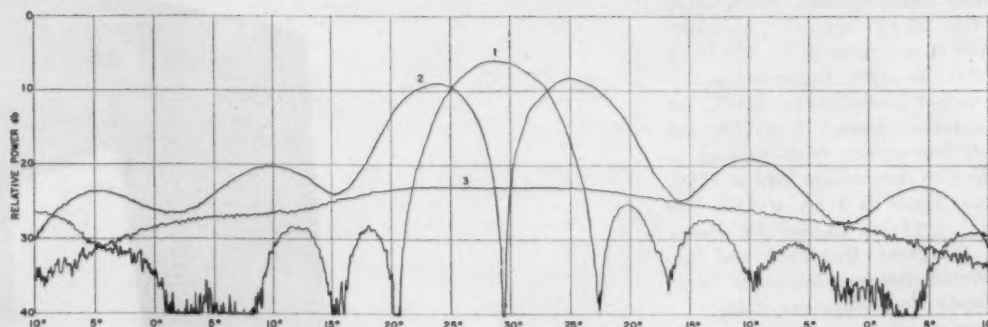


FIG. 1. "SWEEP VOLUME EFFICIENCY" describes a new circularly bi-polarized antenna design for space tracking, range surveillance and communication.

For the last three years, GB Electronics Corporation has been developing and utilizing a unique "Swept Volume Efficiency" end-fire element array technique for use in fan and pencil beam bipolarized antenna systems in the 20 to 40 db gain range. The end fire elements used are of the disc-on-rod type, which when properly arranged in a circular array and fed in equal amplitude and phase through a parallel coaxial feed system, lead to a tracking antenna having the following properties: (1) antenna diameter is about $\frac{1}{3}$ smaller than a paraboloid for the same gain, beamwidth and max side lobe levels; (2) accurate and stable phase comparison tracking information can be obtained; (3) full antenna gain is available on axis for communication; (4) beamwidth may be rapidly widened for acquisition capability; (5) and the bandwidth over

FIG. 2. ANTENNA PATTERNS for 242 mc SVE antenna. The three curves are: (1) RHC Sum; (2) RHC Difference and (3) RHC Broadband.



which accurate tracking can be maintained is very large, and can be further extended by interlacing different frequency band arrays on the same antenna structure.

The 44' NASA Array at Wallops Space Flight Station, Va. will provide all functions of a 60' paraboloid in the VHF telemetry band and in addition will provide advantages in acquisition and tracking accuracy. It is applicable to Active or Passive tracking of Spacecraft, Range Safety and Communication.

The end fire element chosen for NASA was initially designed at S band; when scaled to 242 mc, the structure is about 12 feet long and is cantilevered from the back-up structure. The energy is launched along the element by 4 dipoles, arranged in a square and mounted in a cupped ground screen about 4 feet on a side. Opposite dipoles are fed in parallel, and the two pairs allow reception of orthogonal polarizations with greater than 30 db decoupling. This element has a maximum of 14.7 db gain above isotropic at mid-band, and about 13½ db gain at the edges of the band. The VSWR of the sum channel is less than 1.5:1 over the band.

The 33 element array of SVE elements of the type described has a maximum diameter of 44 feet and provides a minimum gain of 28 db above a similarly polarized isotropic radiator, measured at the sum channel junction box input. The half power width of the sum beam is nominally 5½° and the maximum sum pattern side lobes are at least 20 db below the peak in every plane through the array (Fig. 2).

The antenna has 4 outputs per polarization, two sum outputs for diversity and two different outputs (azimuth and elevation). Since the antenna is bipolarized, provision is made to interconnect the orthogonal output through other hybrids in the junction box to obtain either right or left circular polarization on both the sum (telemetry) and tracking outputs.

The center element is fed separately by a directional coupler located beyond the point at which the quadrants are joined by the comparator hybrids. A solenoid operated coaxial switch connects only this element to the sum output for beam spreading, widening the beam from 3° to 30° in 20 milliseconds. The tracking outputs remain separately available... (From 6-page technical brochure, "Swept Volume Efficiency," GB Electronics Corporation, Subsidiary of General Bronze Corp., Garden City, L. I., N. Y.)

FOR MORE INFORMATION CIRCLE 114 ON READER-SERVICE CARD

Polaris Trainer Simulates Navigation Problems



STAR-TRACKING PERISCOPE, part of huge Polaris Submarine navigational training simulator is an exact mockup of new Fleet Ballistic Missile submarine.

The new Polaris (FBM) Navigation Center Device X21A37, developed and built by Reflectone Electronics, Inc., Stamford, Conn. in close association with the Electric Boat Co., Div. of General Dynamics, under contract with the U. S. Navy Devices Center, Port Washington, N. Y., is designed to operate in conjunction with diving and missile-launching simulators housed in the same building.

The navigational portion of the Polaris simulator permits a faithful reproduction of that portion of the celestial globe a crew will be sailing under at any future time, in any sea. Polaris submarines are manned by two crews in rotation. A "gold" crew operating the submarine for several months will return, be replaced by a "blue" crew, and maintain proficiency in the trainer until it is scheduled to "relieve the watch."

Because of the wide range of latitudes and operational conditions which can be simulated, the new trainer not only provides training more cheaply than could be done by actual conditions, but better—because extreme conditions only experienced in combat can be simulated without peril, and enough times for the crew to become proficient.

CIRCLE 406 ON READER-SERVICE CARD

'PUTS THE REPRODUCTION OF COPY ON AN AUTOMATIC BASIS'

CHARLES HUESTIS
Treasurer and
Director of Finance



Copyflo®11 Printer saving Hughes \$300,000 a year

A Copyflo 11 continuous printer is saving Hughes Aircraft Company more than \$300,000 a year in the reproduction of engineering drawings, correspondence, reports, and administrative documents. Engineering prints, however, form the bulk of the copying work.

So fast is the Copyflo continuous printer in comparison to manual reproduction methods previously used that Charles Huestis, Hughes' treasurer, says, "It puts the reproduction of copy on an automatic basis."

This is scarcely an overstatement. A Copyflo continuous printer automatically turns out a different 8½"x11" print every three seconds, an 11"x17" print every six seconds.

A Copyflo continuous printer automatically produces—at the rate of 20 linear feet a minute—dry, positive prints

or offset paper masters, ready for immediate use. The machine operates on the principles of xerography—clean, fast, completely dry—copying anything written, printed, typed, or drawn.

Copyflo printers reproduce from original documents or from microfilm. They enlarge, reduce, or copy size to size, and use ordinary paper.

The volume of your daily copying may well justify a Copyflo continuous printer, too. Why not find out now how much you can expect to save in time, money, space, and materials? Let our trained systems and procedures man make a free analysis of your paperwork-duplicating needs. Write XEROX CORPORATION (formerly Haloid Xerox Inc.), 61-200X Haloid St., Rochester 3, N.Y. Branch offices: principal U.S. and Canadian cities. Overseas: Rank-Xerox Ltd., London.

push the button
and copies flow!



XEROX

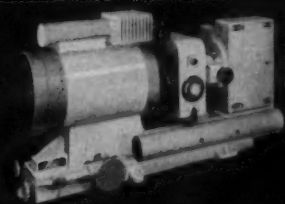
CORPORATION

CIRCLE 24 ON READER-SERVICE CARD



WITH ZOOMAR

REFLECTAR
MIRROR OPTICS
Focal Lengths: 20",
40", 80", 100", 150",
16mm, 35mm, 70mm
motion picture and
TV cameras.



LONG RANGE



TRULEX
AUTOMATIC
EXPOSURE
CONTROL

OPTICAL EQUIPMENT



SERVICE COLLIMATOR

For checking long range lenses and cameras in the field.

Write or call for literature
Dept. MSD-5/61.



CIRCLE 25 ON READER-SERVICE CARD



FIG. 1. NONCONTACT Magnetic encoder (left) and contact-type subminiature Size 8 encoder (right).

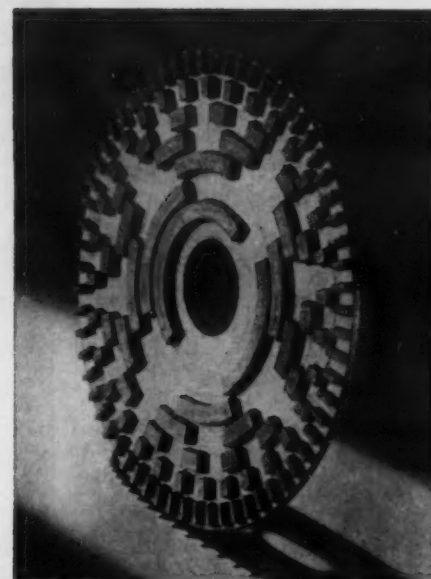


FIG. 2. FERRITE encoder disc used in noncontact-type magnetic encoder.

Shaft Position-to-Digital Encoders

Two new shaft position-to-digital encoders, recently developed at the Burbank Branch of Librascope Division, General Precision, Inc., now provide design engineers with analog-to-digital converters for applications (1) where space is very limited, or (2) where extreme reliability, high speed and long life are most important.

The subminiature Size 8 contact-type encoder fulfills requirements in missile, aircraft, and other applications where space is limited. In applications where space is not a severely limiting factor, the new noncontact magnetic encoder can be utilized. The noncontact encoder performs with high reliability, long life, and high speed in navigation, guidance, and fire control systems, and in machine tool control, data logging, and other exacting position-to-digital applications. Both encoders are shown in Fig. 1.

The Size 8 encoders are 0.75" in diameter and—depending on capacity—0.560", 1.302", or 2.050" long. Available in three models—each having a resolution of 128 counts per input shaft revolution—total capacities are 2^7 , 2^{13} , and 2^{19} binary counts.

Despite its minimum size and weight, with the proper readout and logic circuitry, the Size 8 unit is capable of every operation performed by its larger counterparts.

Starting and running torques are less than 0.5 oz-in, and operation at ambient temperatures from 0° to 100°C is normal even under severe vibration and high G loads. Operating speeds of 0 to 200 rpm are possible. Tests under exacting conditions indi-

cate a potential life of 10×10^6 revolutions at 200 rpm, the equivalent of 833 hours of continuous operation.

A most important feature of both encoders is the method of eliminating possible readout ambiguity. This ambiguity arises from the fact that in some positions more than one binary bit is changing state. In the contact-type encoder, this difficulty is eliminated by using two brushes on each bit track except for the least significant bit track, which has only one brush. This least significant brush is the controlling element, determining through simple external logic circuitry which of the two brushes on the next-most-significant track will be used. This selected brush then becomes the controlling element for its adjacent next pair, etc. (In non-contact magnetic encoders, double V-scanning sensing heads—rather than brushes—are used).

Librascope's new noncontact magnetic encoders have been subjected to severe tests where they have operated successfully for more than 20 million revolutions at 1000 rpm. These tests indicate a life expectancy of over 20,000 hours.

The magnetic technique, developed by Librascope, utilizes changes in the magnetic induction of toroidal ferrite readout cores to generate two-level voltage signals which can be arbitrarily designated as binary "ones" or "zeros." Signals are generated in response to the presence of the readout cores next to raised and depressed portions of a ferrite disc driven by the input shaft. The raised and depressed

MILITARY SYSTEMS DESIGN

portions of the ferrite disc, Fig. 2, form a coded pattern which is a binary representation of the angular position of the disc. Raised portions of the disc represent binary "zeros," depressed portions represent binary "ones."

An alternating current source drives the cores. To assure maximum reliability of core switching, the driving current and number of turns of the winding are fixed at values required to drive the core to magnetic saturation just before the completion of each half cycle of the driving signal. The driving circuit consists of the alternating current source, a fixed resistor, and the core (Fig. 3).

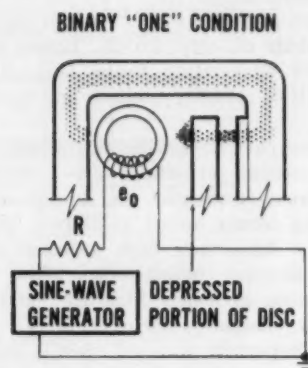


FIG. 3. NONMAGNETIC ENCODER operation schematic. When depressed portion of disc is in magnetic path, flux of fixed field does not saturate toroidal core, and core impedance is high, resulting in binary "ONE" output. When raised portion of disc is interposed in path, high field flux saturates toroidal core, causing low core impedance, with binary "ZERO" output.

Simultaneously a unidirectional magnetic field is being set up in the magnetic housing circuit by the fixed field coil. This magnetic circuit is completed through the ferrite toroidal core and the ferrite code disc. When a raised portion of the ferrite disc is in the magnetic circuit, the impedance of the toroidal core winding is small and the resulting output (e_o) across the core winding is small. Thus the presence of the raised portion of the code disc produces a binary zero (0) output.

Conversely, when a thin portion of the ferrite disc is interposed in the magnetic circuit the increased reluctance due to the wider air gap weakens the mmf available to oppose the core-driving mmf. As a result, the output impedance of the toroidal core is high and the output voltage (e_o) across the core winding is at a maximum, producing a binary one (1) output.

Since the output voltage is in the order of 8 volts peak-to-peak, solid-state isolation diodes may be used within the encoder to permit as many as 20 encoders to be multiplexed. (From article of same title, *Librascope Technical Review*, Vol. 3/1, Librascope Division, General Precision, Inc., Glendale 1, Calif.)

FOR MORE INFORMATION CIRCLE 115 ON READER-SERVICE CARD

find the solution to your printing problems at Clary

... America's foremost producer of printers

Other Clary printers include:



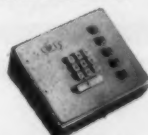
TIME-DATA PRINTER. Accepts remote source information, records it with exact time to nearest second.



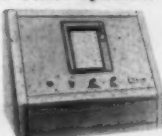
TAPE PERFORATOR. Records data on punched tape. Has self-contained power supply, parallel to serial converter.



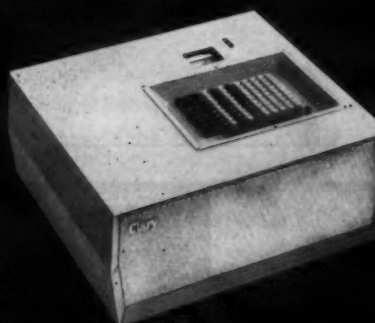
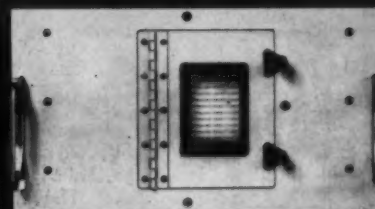
PRINTING TIMER. Measures and prints elapsed time and sequential number of operations in series.



INPUT DATA UNIT. Works with any computer, check-out, data-logging, testing, or other system.



COMMERCIAL PRINTER. Utilizes the Militarized printer's principle of reliable high-speed motion.



MILITARIZED PRINTER:

Uses an exclusive printing method that ends critical timing problems, messy ribbon changes, bleeding of ink into paper. Prints up to 21 characters per line, 600 lines per minute. Withstands 50G shock, prints in sub-zero temperatures, and under other extreme conditions. Used on new nuclear subs, and on the Polaris, Minuteman, Atlas missile programs.

SCANNING PRINTER:

Accepts decimal and binary coded data on the same line, at no extra cost. Operates directly from the voltage output, draws negligible power from data source. Color-prints outputs from digital voltmeters, shaft position transducers, electronic counters, digital clocks, etc. at 3 lines per second, with 12 digits per line capacity. Fewer moving parts make it more reliable.

SOLENOID PRINTERS:

One of the world's largest selection of standard, serial entry, and parallel entry printers. Choose the exact one you need for your business, industrial, or instrumentation application. Simple circuitry, engineering experience make them more reliable; production-line economies make them lower in cost. Seven-day delivery, or custom-designed to your specification.



Clary

ELECTRONICS
San Gabriel, California

In Canada: Computing Devices of Canada, Ltd., Ottawa

Let Clary help you solve your printing problems.
Just write or call direct.

CIRCLE 26 ON READER-SERVICE CARD

Snap-Action Thermal Delay Relay

The Curtiss-Wright "Snapper" Type S Relay is a thermal delay relay in which a bimetal element is heated by a separate controlling circuit to cause a mechanical deflection of the bimetal. It includes a toggle snap action assembly which is mechanically activated by the bimetal element to snap from one stable state to the other when the bimetal has reached a predetermined deflection (Fig. 1).

The moveable contact arm of the relay is pivoted on a compensating bimetal element which is affected to the same extent as the operating bimetal element by ambient temperature. This cancels the effect of ambient temperature on the relay operating time.

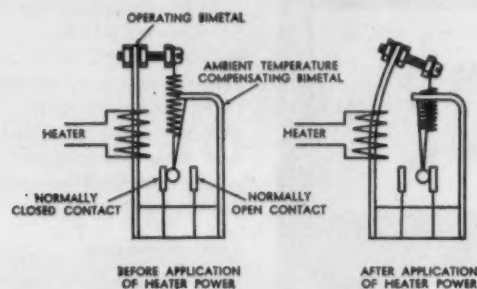


FIG. 1. OPERATION of "Snapper" Thermal Relay.

Type S relays are preset at the factory for time delays from 3 to 60 seconds. Furnished with 7-pin miniature, 8-pin octal, 9-pin miniature and 7-hooked solder terminal bases, the Type S relay is hermetically sealed metal envelope for operation up to 70,000 ft altitude (Fig. 2).

Heaters are furnished for standard 6.3, 26.5 and 117 v, with other voltages from 5 to 125 v ac or 28 v dc resistive load. (From 44-page Components Department Catalog, Electronics Division, Curtiss-Wright Corporation, 35 Market St., East Paterson, N. J.)

FOR MORE INFORMATION CIRCLE 116 ON READER-SERVICE CARD

FIG. 2. CUTAWAY view of hermetically sealed "Snapper" Thermal Relay, providing from 3 to 60 seconds delay on from 2.5 to 3.9 watts actuating power.



Solid-State Porcelain Capacitors

New "VY" Solid-State Porcelain capacitors—manufactured from #155 Frit and meeting all requirements of MIL-C-11272/5 through /12—are stable, low-loss units ideally suited for use in tuned circuits, high power RF applications, high frequency designs or other applications where low loss, high stability, reliability or complete predictability of electrical characteristics are desired (Fig. 1).

Design center curves showing the effects of temperature on porcelain capacitors are given below. The per cent of capacitance change due to temperature is extremely stable. All "VY" capacitors will trace the curve given in Fig. 2 within 5ppm with a maximum drift of only 0.05%. Losses are low over the entire temperature range (Fig. 3). Life testing per MIL-C-11272B produces no appreciable change.

Design center curves showing the effects of frequency on porcelain capacitors are given below. High self-resonant frequencies and low losses make these capacitors ideally suited to critical high frequency circuits. Also, their high dielectric strength and excellent thermal characteristics allow the capacitors to handle extremely high RF currents for their size. Low dissipation factor (Fig. 4) at high frequencies is important in tuned circuits and high-current operation. In some high-frequency and bypassing applications, the self-resonant frequency may be exceeded since the capacitor will still block dc. The reactance will still be low as long as the self-

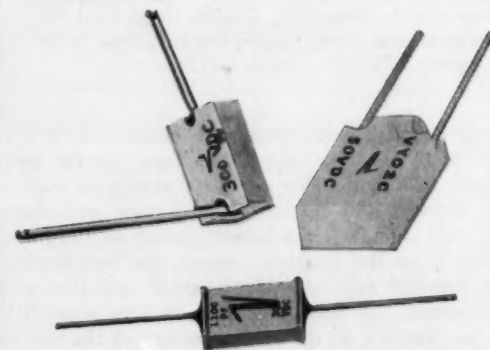


FIG. 1. "VY" AXIAL-RADIAL (top left), End-Radial (right) and Axial Type low-loss, stable Solid-State Capacitors are space-saving and rugged.

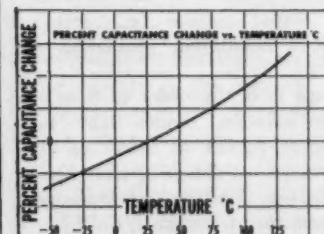
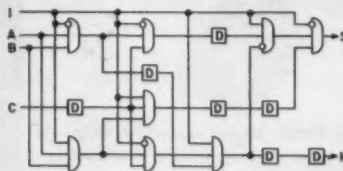


FIG. 2. All "VY" Capacitors will trace this curve within 5 ppm.

The binary adder stage produced in conventional design (top) has been reduced and simplified through Majority Logic Design to the diagram and formula at the bottom. Discovered and formulated in the Remington Rand Univac Mathematics and Logic Research Department, Majority Decision Logic is a new logical algebra, which opens new and interesting possibilities for the reduction in the number of logical elements in computer design.

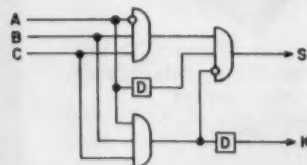
$$K = (A+B) \cdot C + A \cdot B$$

$$S = (A \cdot B \cdot C + \bar{K}) \cdot (A+B+C)$$



$$K = A \oplus B \oplus C$$

$$S = (\bar{A} \oplus B \oplus C) \oplus A \oplus \bar{K}$$



Univac now has a number of opportunities for participation in exceptionally interesting projects which offer both professional and personal reward. These positions are significant in their potential for advancement.

The following are among those openings immediately available to experienced, capable people:

- COMPUTER APPLICATIONS ANALYSTS
- MILITARY SYSTEMS ANALYSTS
- INFORMATION STORAGE AND RETRIEVAL SPECIALISTS

- COMPUTER PROGRAMMERS
- COMPUTER LOGICAL DESIGNERS
- OPERATIONS RESEARCH ANALYSTS

Send resume of experience and education to: R. K. PATTERSON, Dept. FF-5

All qualified applicants will be considered regardless of race, creed, color or national origin.

Remington Rand Univac

Division of Sperry Rand Corporation • Univac Park • St. Paul 18, Minnesota



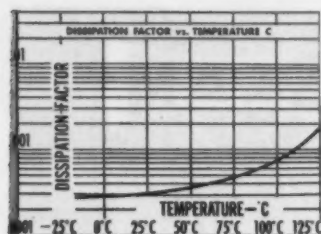


FIG. 3. Losses are low over the entire temperature range.

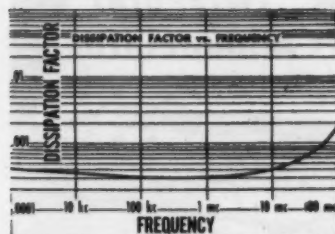


FIG. 4. Low dielectric absorption, monolithic construction and low inductance combine to give low losses even at high frequencies.

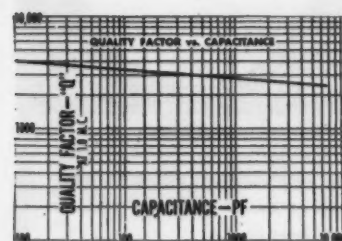


FIG. 5. "Q" is high even at high capacitance values.

resonant point is not exceeded by too wide a margin.

Where the Q of many capacitors drops off at low capacitance values, the Q of "VY" capacitors exhibit a uniform rise (Fig. 5). Q, the inverse dissipation factor, is of primary interest in tuned circuits. (From 14-page Vitramon Capacitors catalog 1961-1, Vitramon, Inc., P.O. Box 544, Bridgeport 1, Conn.)

FOR MORE INFORMATION
CIRCLE 117 ON READER-SERVICE CARD

CIRCLE 27 ON READER-SERVICE CARD →

ENGINEERING NEWS - #10

LIGHTED PUSHBUTTON SWITCHES

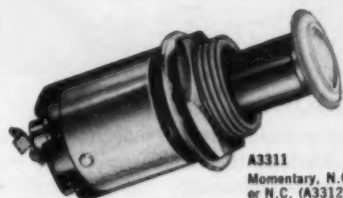
CHECKED

Hed

ENGR.

W.E.M.

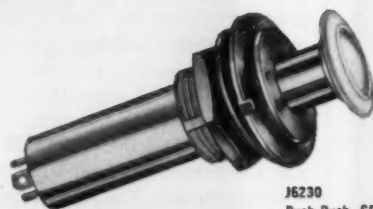
CONTROL SWITCH DIVISION



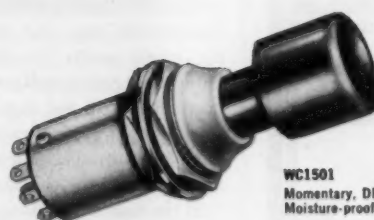
A3311
Momentary, N.O.,
or N.C. (A3312)



A3298
Momentary, SPDT



J6230
Push-Push, SPDT



WC1501
Momentary, DPDT,
Moisture-proof



TWINLITE . . . lights in 2 colors

Here is a low-cost lighted pushbutton containing two lamps which may be individually circuited. Plastic lens is 1" x .740", and comes in one solid color, two-color split, engraved or with a nameplate slot. Select double-pole or triple-pole switching with push-push, momentary, or solenoid-held action. TWINLITE mounts individually with barriers, in rows, or a matrix.

These five models indicate only a part of the full line of SWITCHLITES made by Control Switch Division.

These units combine both switch and indicator light in a single rugged, compact assembly. They are available with momentary, push-push, or push-pull snap-action, having a positive feel. There are eight basic case styles, 20 circuit arrangements. Switch ratings from 2 to 20 amps, ind. or 10 to 20 amps, res. at 28 VDC—depending on switch type, circuit, and required operating life. Switchlites use a midjet flange base MS25237 lamp, 6, 14 or 28 volts. Choose from five styles of plastic pushbuttons in standard transparent and translucent colors.

In other words, almost any requirement you may have for a compact lighted pushbutton is available in a standard SWITCHLITE from Control Switch Division. For more technical data write for free literature.

Manufacturers of a full line of switches, controls and indicators for all military and commercial applications. All standard units stocked for immediate delivery by leading parts Distributors.

CONTROLS COMPANY



OF AMERICA

CONTROL SWITCH DIVISION

4262 West Lake Street • Chicago 24, Illinois
TELEPHONE: VAn Buren 9-3100 • TWX-CG-1400



HIGH-ACCURACY PRECISE ANGLE INDICATOR

NEW KEARFOTT UNIT ACCURATE TO ± 6 MINUTES

The new CO 2721011 Precise Angle Indicator features an accuracy of ± 6 minutes. Latest addition to the Kearfott line of standard test equipment, the unit is designed to meet a wide range of applications. Typical Applications

- Indication of gyro angle of pitch, roll, or yaw and relaying of signal to any preselected impedance or voltage level.
- Indication of shaft position of remote synchro or resolver, and transmission of this information to any impedance or voltage level.
- Display of difference between two shafts when driven by transmitter and differential synchros.

In addition to high accuracy the instrument combines a number of other prominent advantages: it requires only a single power source; it has good sensitivity; it is designed for modular application; and it offers direct automatic read-out. The unit is of extremely compact construction and is built for maximal ease of maintenance.

The low-cost CO 2721011 Precise Angle Indicator is available with a single sensor, auxiliary dual-input sensor, or an auxiliary retransmitter. For additional information on this new test instrument, write for the brochure which describes its operation and capabilities in detail.

SPECIFICATIONS

Repeatability ± 1.2 min	Slewing Speed	7 sec/180°
Readability 0.5 min	Power (single source)	115 v, 1 ϕ , 400 cps
Input Power 30 va	Size	1 3/4 x 9 1/2 x 9 1/4 in.
Sensitivity 1.0 min	Weight	4 lbs.

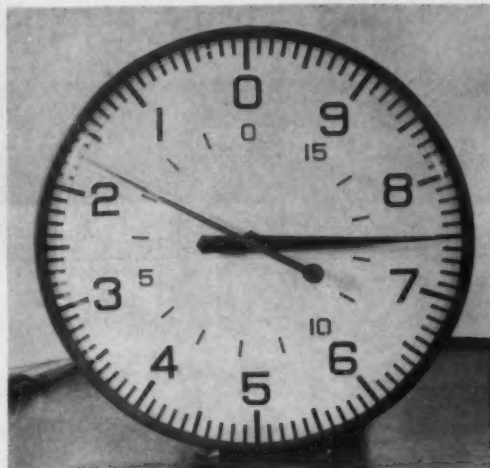
Write for complete data



**KEARFOTT DIVISION
GENERAL PRECISION, INC.**

Little Falls, New Jersey

CIRCLE 28 ON READER-SERVICE CARD



Count-Down Clock

A countdown residual time indicator designed for the peculiar needs of the Air Force TITAN missile is announced by the Automatic Timing & Controls, Inc., of King of Prussia, Pa. The clock was developed by them in response to a request from the prime contractor for TITAN, The Martin Company's Denver Division. It indicates time remaining to count-down zero than showing the time elapsed.

The clock has a 16" diameter face with two pointers driven by a synchronous motor (Fig. 1). The primary pointer makes one revolution in 1000 seconds and the sweep pointer makes one revolution in 10 seconds. Electromechanical components which meet MIL-Spec requirements for ground support areas include: Three graduated index wheels with positive detent mechanisms providing for three predetermined stops, three electromagnetic clutches and the synchronous motor.

The function of the system is to pace (in time) the readying of the missile. The missile gives out a series of six electrical signals, in sequence but at variable intervals, during the course of a normal countdown. The clock must keep in step with the missile.

In operation, the clock's primary pointer moves counter-clockwise to the 15-minute mark and immediately fast-advances clockwise to the first predetermined stop, the starting position. On command, the clock starts its clockwise count-down to zero. Under normal conditions, the programmed functions keep pace with the clock, and the subsequent manually preset tops are automatically removed upon signal from the missile, allowing the clock to proceed to zero whereupon the timer shuts itself down.

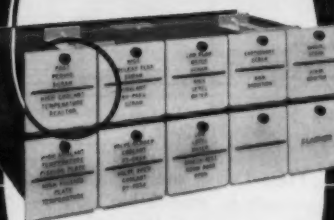
If the launching program either leads or lags behind the clock, the system will compensate in one of two ways: First, should the clock get to the second or the third stop before the missile, the clock will wait at the stop until the missile gives the signal to withdraw the stops after which the countdown proceeds. Second, if the missile arrives at the position (in time) of the second or third stop before the clock, it signals the clock which executes a "fast advance" to that stop, bringing the clock into synchronism with the missile. The next signal from the missile withdraws the stop and again starts the countdown to zero.

FOR MORE INFORMATION CIRCLE 407 ON READER-SERVICE CARD

SCAM

*A Heritage
of Quality*

**De-line
TWINPOINT
Annunciator**



**with new
MAGNA-PLAC
nameplates**

**Two complete alarm points
in each cabinet position con-
serve panel area and reduce
system cost.**

- Nearly 5 sq. inches of engraving area for each point
- AO and AF sequences standard
- Conforms to regular De-Line construction features & quality
- All plug-in units are hermetically sealed

**SCAM[®] INSTRUMENT
CORP.**

3101 N. Lowell Ave., Chicago 41, Ill.
Representatives in all principal cities

FOR MORE INFORMATION
sign and attach coupon to company
letterhead.

NAME _____

CIRCLE 29 ON READER-SERVICE CARD
MILITARY SYSTEMS DESIGN



**NOW —
FOR CIRCUIT
DESIGNERS**

THERE IS AN OWEN SEMICONDUCTOR TEST SET TO MEET YOUR NEEDS AS A CIRCUIT DESIGNER

OWEN TEST SET TYPE	TRANSISTORS			DIODES	ZENERS	SCRs, GTRs, Switching Devices	AC Current SCRs, Rectifiers
	Small	Med	Large				
210-A	•						
210	•	•		•	•		
200		•	•				
200 & 203		•	•			•	
220						•	•

WORTH WRITING FOR:
"HOW TO CUT DESIGN COSTS
WITH SEMICONDUCTOR
TEST SETS"



OWEN LABORATORIES
55 BEACON PLACE
PASADENA CALIFORNIA

CIRCLE 30 ON READER-SERVICE CARD



NEW AUTO-THERM WIRE STRIPPER

for Semi-Automatic Stripping

Strips Fiberglass, Teflon, Vinyl, cotton, Nylon, etc. Any size to 3/8" diameter including coax, shielded, irregular-shaped. Has solenoid-actuated operation. Rotating head strips hard-to-remove insulation. Capacity in excess of 1000 ends per hour. Heated elements sever the insulation. Cannot nick or cut the finest wire strands. Tension adjustment eliminates crushed wire. Built-in ventilating system.

Price \$395 FOB Altadena, Calif.

Western Electronic Products Co.
2420 North Lake Avenue, Altadena, Calif.

CIRCLE 31 ON READER-SERVICE CARD

May-June, 1961



Control Knob Chart

Quick Knob Data for design engineers is available in a 22" x 34" permanent chart which lists over 345 styles of standard control knobs. Tactile Shape Control Knobs per Navy Dwg. RE10F651A are included. All knobs are manufactured in full compliance to MS-91528B. (Available on request from Industrial Components Division, Raytheon Company, Newton 58, Mass.)

FOR MORE INFORMATION CIRCLE 118 ON READER-SERVICE CARD

Automated Information Storage and Retrieval



New FMA FileSearch is the first automated information storage and retrieval system to combine practicality with reasonable economy. FileSearch makes possible the complete indexing and storage of information on microfilm reels. Now over 1,500,000 indexed document pages can be stored in one standard four-drawer filing cabinet. A 100% thorough search of desired documents is automatically conducted at the rate of 6,400 pages per minute, producing low-cost hard-copy or film prints when desired . . .

Storage. Incoming documents are filmed together with their descriptive indexes onto strips of microfilm . . . stored on reels up to 1000 feet in length. These require little storage room, compared with conventional document storage. This system obviates the need for supplementary files like card catalogs. Everything is contained on film . . . (From 10-page brochure FMA, Inc., 142 Nevada St., El Segundo, Calif.)

FOR MORE INFORMATION CIRCLE 119 ON READER-SERVICE CARD

SHOWN FULL SIZE



KEARFOTT SYNCHRONOUS MOTORS

High performance components, these motors find application in timing devices, recorders, or wherever constant speed is required independently of load or line voltage variations. Designed for 400 cps duty they feature homogeneous rotors and closed stator slots to eliminate magnetic pulsations and noise.

Stainless steel is used extensively in the construction of these precision motors to provide environmental protection from corrosion shock and vibration. These components will operate over the temperature range of -54°C to +125°C.

SPECIFICATIONS

Size	Part Number	Synchronous Speed	No. Phases	Pull-Out Torque
5	CJO 0172-002	8000 rpm	2	0.10 in. oz.
8	M172-02	8000 rpm	2	0.28 in. oz.
8	CM4 0172-001	8000 rpm	3	0.31 in. oz.
11	R172-001	8000 rpm	2	0.42 in. oz.
15	T170-001	8000 rpm	2	0.78 in. oz.
18	MK 6 Mod 1	8000 rpm	3	2.2 in. oz.
23	Z1360-002	8000 rpm	3	16.0 in. oz.

Write for complete data



**KEARFOTT DIVISION
GENERAL PRECISION, INC.**

Little Falls, New Jersey

CIRCLE 32 ON READER-SERVICE CARD



High and Medium Temperature MULTI-CONDUCTOR CABLE For Critical Applications

TIMES' experience in designing and manufacturing R.F. coaxial cable, data transmission cable, and low frequency control cable adds up to multi-conductor versatility to solve your problems.

As a "one source" manufacturer of all multi-conductor cable components, TIMES can produce round and ribbon cables utilizing almost infinite combinations of coaxial cable, Teflon®, PVC and polyethylene hook-up wire, and low capacitance cable.

Choose from TIMES standard engineered multi-conductor cables, or let our Engineering Service assist you in designing cables and cable assemblies to meet your specific requirements. © DuPont

TIMES WIRE & CABLE DIVISION
The International Silver Company
WALLINGFORD, CONNECTICUT, U.S.A.

Clip This Coupon To Your Calling Card or Letterhead

Please rush FREE literature on:

- ☐ Coaxial Cables
☐ Data Transmission Cables
☐ Multi-Conductors & Hook-up Wire
☐ For Info. Only ☐ Have Rep. Call



CIRCLE 33 ON READER-SERVICE CARD

Dry Reed Relays



FIG. 1. BASIC DRY REED switch capsule encloses two magnetic contacting elements in an inert atmosphere.

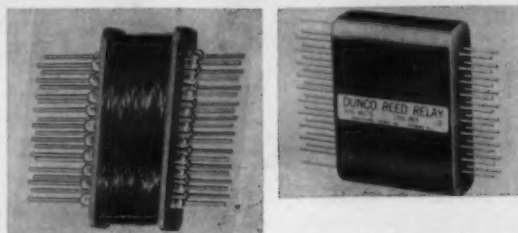


FIG. 2. TWENTY CONTACT ELEMENTS operated by a single coil are encapsulated with only the terminals exposed.

Exceptionally fast low-level and light load switching for computer and data handling can now be standardized by convenient and economical Dunco Type RR Dry Reed relays. Available in standard encapsulated types in 1, 2, 4, 12 or 20 poles, each switching element is a separate basic dry reed switch (Fig. 1) consisting of two magnetic elements with diffused gold contact surfaces hermetically sealed in a glass capsule. An inert atmosphere surrounds the contacts, minimizing arcing and preventing contact corrosion. Contacts are

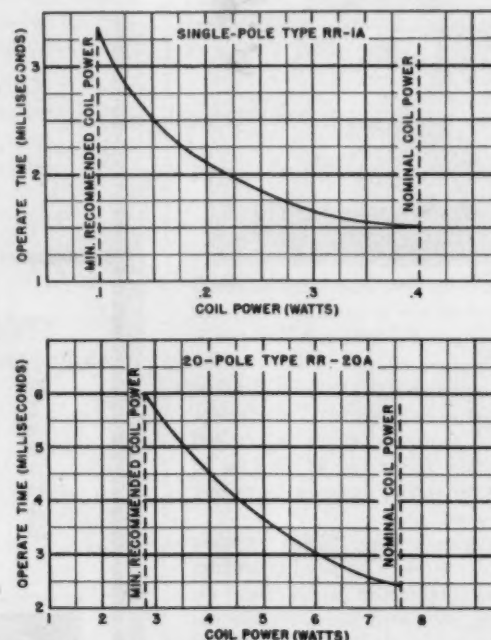


FIG. 3. OPERATING POWER vs. operate times in milliseconds are shown in relay characteristic curves for single-pole and 20-pole Dunco Type RR Dry Reed Relays.

impervious to atmospheric contamination and indifferent to altitude.

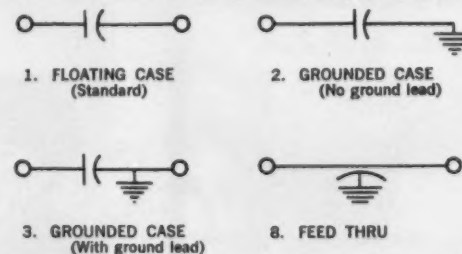
Up to 20 contact elements are enclosed within a single operating coil. The entire assembly is then encapsulated with only the terminals exposed (Fig. 2). Operating times of reed relays vary with power input. Curves showing operating power vs. operate times in milliseconds are given in Fig. 3 for the single pole and 20 pole standard assemblies. Any arrangement of Normally open and normally-closed contacts may be provided. Where desired, Break-Make action can be furnished to insure non-overlapping of contact closures. Multicoil arrangements for logic elements can be supplied.

Life expectancy of the Dunco Dry Reed Relays is in the order of hundred of millions of operation on dry circuit and other light load applications. In many instances they replace solid state switching devices at considerable savings because their circuitry is far less costly and complex. (From 4-page Data Bulletin RR-2 and 2-page Information Bulletin RR-1, Struthers-Dunn, Inc., Pitman, N. J.)

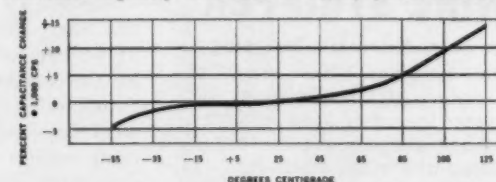
FOR MORE INFORMATION CIRCLE 120 ON READER-SERVICE CARD

Metallized Mylar Capacitors

Miniature metallized mylar capacitors designed for complex circuits requiring maximum space, economy, superior reliability and high performance are now available from Hopkins Engineering Co., as film-wrapped and molded types and in all case styles and sizes in hermetically sealed tubes and bathtubs.



Internal circuit arrangements possible are as shown in Fig. 1. Standard capacity values range from .005 μ f to 1 μ f in dc voltage ratings of 200, 300, 400 and 600 v. Capacities up to 8 μ f at 200 v are also available. Standard capacity tolerance is $\pm 20\%$, but tolerances



down to $\pm 1\%$ measured at, or referred to 1,000 cps and 25°C are available on request.

All units will withstand 140% of rated voltage for a life test of 250 hours at 125°C. Capacitance stability of Metallized Mylar capacitors shows a -6% for temperatures from -55°C to 25°C, 6% change from 25°C to 85°C, and 15% change from 85°C to 125°C (Fig. 2).—(From 8-page Catalog No. C-103B, Hopkins Engineering Co., 12900 Foothill Blvd., San Fernando Calif.)

FOR MORE INFORMATION CIRCLE 121 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

ACHIEVEMENT IN PRECISION

Precision in design and manufacture is not sufficient to put your product up in the PRECISION orbit. Precision in thought, resulting in precision planning and organization is also required. This faculty which underlies our creative engineering, our craftsmanship and our manufacturing skill is our greatest resource. To this we owe our leadership in the design and manufacture of precision electrical, electro-mechanical and electronic products for the modern, ever-growing fields of instrumentation and automation.



Send for your copy of
The Boehme Brochure, now!
There is no obligation,
of course.

H. O. Boehme, Inc.

Contractors, Designers, Manufacturers
of Precision Electrical, Electro-
Mechanical and Electronic
Equipment since 1917



915 Broadway
New York 10, N. Y.

CIRCLE 34 ON READER-SERVICE CARD

May-June, 1961

Precision FM Data System

The Daystrom-Wiancko Secondary Standard consists of a precision FM oscillator, an integral power supply, and a plug-in unit containing a selected, precision Wiancko pressure pickup with heater and thermostat, all housed in an attractive, portable carrying case.

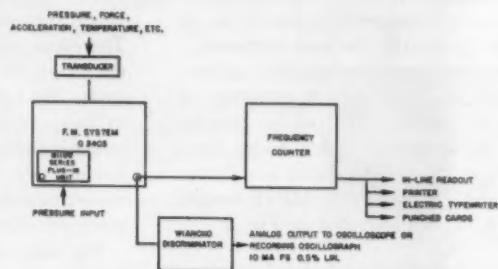


FIG. 1. SINGLE-CHANNEL FM System, Block Diagram.



FIG. 2. SECONDARY STANDARD Type Q3403 in laboratory set-up.

The Secondary Standard can be used as a single channel FM telemetering system for remote measurement of pressure, force or acceleration by connecting a Wiancko pickup to the parameter to be measured and cabling back to the Standard (Fig. 1). Although accuracies quoted for the Standard will be modified somewhat due to cable effects, accuracies of 0.1% are possible if cable lengths do not exceed 500 feet and a quality grade of cable is used.

The Secondary Standard is shown in a laboratory setup in Fig. 2. Being completely portable, it can also be used in the field. Plug-in frequency multiplier, 2x or 4x, is available to multiply the 2500-cycle deviation by 2x or 4x to provide real data with high resolution. For example, with the output frequency multiplied by a factor of 2, the bandwidth is 5000 cps, and with a 500 psi head, pressure could be read directly to 0.1 psi. (From 44-page Systems Engineers Handbook, on specifications of compatible FM system building-block components. Daystrom-Wiancko Engineering Company, 255 N. Halstead, Pasadena, Calif.)

FOR MORE INFORMATION CIRCLE 122 ON READER-SERVICE CARD



14' TO 32'

PARABOLIC REFLECTORS AND ACCESSORIES

Taco parabolic antennas are engineered and built to the highest standards of performance, dependability and versatility. The basic Taco design permits easy transportation, and fast, accurate assembly at installation site. Tolerances are closely held for maximum efficiency. A wide choice of mounts permit tower, ground, remote control, or other mounting installations. Feeds available are dipoles, horns, dual-polarized horns, or special designs to meet customer specifications.

WRITE FOR COMPLETE TECHNICAL SPECIFICATIONS
AND PERFORMANCE INFORMATION...Catalog No. 500

TACO PRODUCTS

<p>Ruggedized yagis CAT. NO. 600</p>	<p>Telemetry and ground base antennas CAT. NO. 300</p>	<p>CAT. NO. 500 Large parabolics from 14' to 32'.</p>
<p>Rigid transmission line CAT. NO. 200</p>	<p>Microwave antennas CAT. NO. 100</p>	
<p>Airborne antennas CAT. NO. 400</p>		

Write for Catalog . . . Defense & Industrial Div.

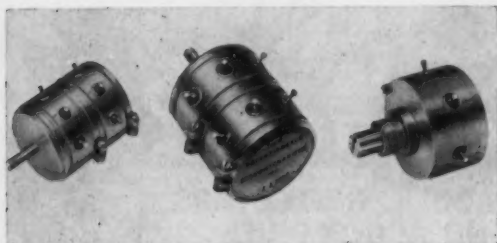
TACO

TECHNICAL APPLIANCE CORPORATION, SHERBURNE, NEW YORK
Area Code 607 • Telephone OR 4-2211

CIRCLE 35 ON READER-SERVICE CARD

High-Resolution Featured in New Precision Potentiometers

Using deposited film techniques, Mechatrol's new 11W series precision potentiometers achieve a resolution of better than 1 part on 20,000 or 0.005%. These position transducers are intended for applications where almost imperceptible increments of shaft rotation must produce definite but proportionally small changes in output resistance.



SYNCHRO-MOUNTING Two-gang Mechatrol deposited-film precision potentiometers are shown center and left. Bushing-mount model is shown at right.

The process of manufacture, said to be unique, deposits the resistive film in a high vacuum chamber using electron bombardment techniques. This method provides a thin film metallic resistance element of extremely fine granularity capable of being resolved into infinitesimally small changes in resistance.

The new potentiometers comply with environmental specifications for airborne and space equipment, featuring superior wear and long rotational life under conditions of high ambient temperature, humidity, severe vibration and shock. They are available in single or ganged types (see Fig.) with shaft and housing features adaptable for servo or panel-mounted enclosures.

Resistance ranges in standard production are from 250 ohms to 50 K, linear functions, 2 watts at 100°C derating to 1 watt at 150°C, and independent linearity within 1%. On special order resistance values to 100K, independent linearities down to 1/4% and noise figure down to 100 is available. Up to nine multiple taps can also be provided on special order. Diameter is 1 1/16", depth of single gang behind panel is 11/16". Each additional gang adds only 9/16" of depth.

Mechatrol, a Division of Servomechanisms Inc., located at 1200 Prospect Ave., L. I., N. Y. are specialists in the manufacture of electro-mechanical precision motors, tachometers and their accessories. The new potentiometer line represents the culmination of over 6 years of development in precision potentiometers.

FOR MORE INFORMATION CIRCLE 123 ON READER-SERVICE CARD

Measurement of Flutter

Although the ear is extremely sensitive to specific types of flutter and flutter rates, it is unable to detect with certainty extremely high flutter rates. In fact, this latter form of flutter resembles, to a great extent, intermodulation products resulting from interaction between high frequency signals and modulation noise behind the signal. (Strangely, it is this kind of flutter which produces the most disagreeable distortion in magnetic recording, and is usually the least suspected.) Because of this uncertainty and the inability subjectively to evaluate both the quality and quantity of flutter, flutter meters are usually employed for precise measurement. A typical sensitive flutter meter constructed in accordance with the standards for flutter and wow measurements as set up by the SMPTE Sound Committee and the I.R.E., is illustrated in Fig. 1.

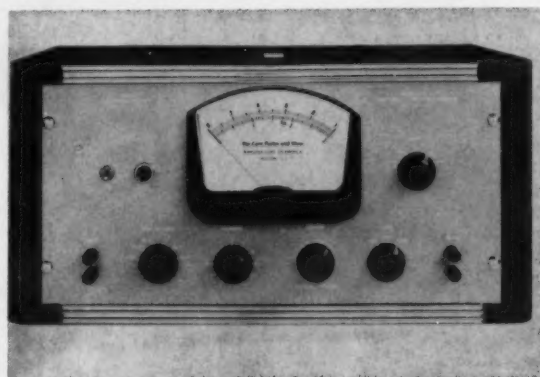


FIG. 1. FLUTTER, wow, and drift may be accurately measured on a sensitive flutter meter. The meter responds uniformly to all flutter, wow, and drift rates from 0 to 250 cycles.

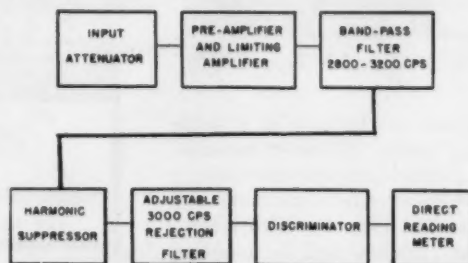


FIG. 2. FLUTTER METER block diagram.

It is particularly desirable to use a meter of this type for direct reading of all of the three basic flutter components—wow, drift and flutter. Three simultaneous readings may be made with but little skill.

A block diagram of the basic elements of the flutter meter is shown in Fig. 2. The instrument operates as follows: The output of the magnetic playback connects into the input of the flutter meter. The input attenuator is adjusted to accept the amplitude of the incoming signal, which is subsequently amplified and fed into a limiting amplifier so that amplitude variations do not affect final flutter reading. An electronic band-pass filter section accepts all signals between

2,800 cps and 3,200 cps and rejects all other frequencies. The output of the band-pass filter is fed through a harmonic suppressor so that virtually a distortion-free signal is fed into the 3,000 cycle rejection filter which is in turn coupled into a discriminator arranged so that the amplitude of all frequency components other than 3,000 cycles is read on the vacuum tube voltmeter.

The built-in pre-amplifier and input attenuator accepts voltages ranging from 1 millivolt to 100 volts. Therefore, connections may be made directly across the magnetic playback head, or across high level circuits. The ballistic characteristics of the meter, as used in conjunction with the limiting amplifier, prevent switching circuits and other extraneous transients from having any effect upon the reading or stability of measurements. Three scales are provided with maximum sensitivities of 0.3, 1.0 and 3.0 per cent.

Variable capacitive and resistive elements provide for accurate calibration and flutter measurements on all recording and playback equipment whose normal linear speed variations fall within ± 5 per cent of standard.

Flutter is measured as the ratio of the root-mean-square deviation in frequency of a standard recorded signal (3000 cps) to the average frequency expressed as a percentage.

The percentage of flutter when expressed as the maximum peak variation of the signal frequency, in terms of its average frequency, develops into the following equation:

$$W = \frac{f' - f''}{f_a} \times 100$$

where W = per cent flutter

f' = maximum frequency

f'' = minimum frequency

f_a = average frequency

If a constant tone of 3,000 cps is recorded and the subsequent playback contains frequencies ranging from 2,950 cps to 3,050 cps, the flutter content of the record-playback system is rated at 3.333 per cent. (From 12-page study, "Flutter," by N. M. Haynes, Amplifier Corp. of America, 396 Broadway, New York 13, N. Y.)

FOR MORE INFORMATION CIRCLE 124 ON READER-SERVICE CARD

JUST OFF THE PRESS—THE ONLY BASIC
BOOK ON THIS IMPORTANT SUBJECT

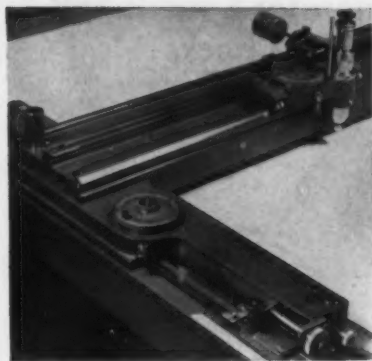
WEIGHT MEASUREMENT & CONTROL

Milton H. Aronson (editor)

Covers: weight standards, calibration facilities, weighing techniques, commercial equipments. Surveys both available apparatus and the equipments of some standards and calibration facilities. This is a practical text, covering principles and practice.

110 + vi pages, illustrated, paper, \$2.00

Instruments Publishing Company Inc.,
845 Ridge Ave., Pittsburgh 12, Penna.



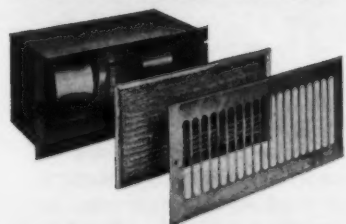
A BETTER PLOTTER

for Precision Layout of Grid Systems and Coordinate Positions

The Coordinatograph, a new, better plotting instrument, is now being used for all types of precision layouts. It plots within .001" over a $47\frac{1}{2} \times 47\frac{1}{2}$ " working table. Rack and pinion construction for counter dials assures accurate measurements. 7 diameter pricker microscope permits observation and plotting in one operation. Radii from 12" to 40" can be plotted with beam compass. Vertically laminated plywood table. Vibration-free tripod mount. Write now for free folder.

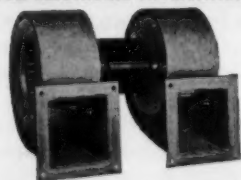
AERO SERVICE CORPORATION
210 E. Courland St., Dept. 111, Phila. 20, Pa.
CIRCLE 36 ON READER-SERVICE CARD

McLEAN



FANS-BLOWERS

FOR ELECTRONIC APPLICATIONS



Hundreds of Models
Fast Delivery
Custom Design

WRITE TODAY
44 Page Packaged
Cooling Catalog



McLEAN ENGINEERING LABORATORIES

World Leader in Packaged Cooling
Princeton, N. J. • WAInut 4-4440
TWX Princeton, New Jersey 636
CIRCLE 37 ON READER-SERVICE CARD

May-June, 1961

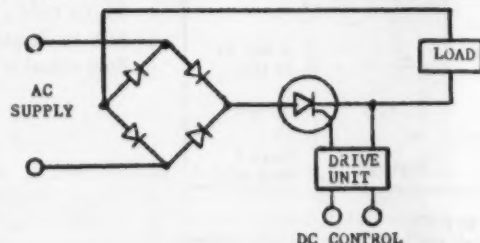
Trinistor Proportional Control

The Trinistor® Controlled Rectifier (Fig. 1) is a three terminal silicon device which can be used to control large blocks of power. Its characteristics are similar to those of a thyatron, in that the device will block voltage in the forward direction below a critical breakover voltage. However, by exceeding the critical breakover voltage or applying a proper gate signal, the device will rapidly switch to the conducting state.

FIG. 1. CONTROLLED Silicon Rectifier has characteristics similar to those of a thyatron.



FIG. 2. TRINISTOR Proportional Control Schematic.



The units are best suited for high power applications up to 300 volts and currents up to 50 amperes. They have a switching time of 600 millimicroseconds with peak reverse voltages of 60 to 360 volts.

A simple circuit in which the Trinistor is used as a control element between a full-wave rectified supply and a load is shown in Fig. 2. The Trinistor in turn is controlled by a phase shifting drive unit. If a dc control signal is applied to the drive unit, it will produce an output pulse every half cycle. These pulses will be phase shifted relative to the ac supply by an amount dependent on the magnitude of the dc control signal.

Since these pulses feed into the Trinistor gate, the Trinistor will be turned "on" with each pulse. It will then stay "on" until the supply voltage goes to zero at the end of the half cycle. In this fashion, a series of chopped sinusoids are produced—the duration of each being determined by the magnitude of dc control signal applied to the drive unit.

The Trinistor controlled rectifier can be used as a replacement for saturable reactors with the usual Magamp driver replaced by a phase shifting Trinistor drive unit. Although a dc output to the load has been shown for clarity, equally simple circuits can be used for ac output . . . (From 2-page Tech Tip No. 3, Westinghouse Semiconductor Dept., Youngwood, Pa.)

FOR MORE INFORMATION CIRCLE 125 ON READER-SERVICE CARD

NOW! IRIG TIME CODE GENERATOR

Output Signals in 7 Convenient Forms



The Hermes all solid-state Time Code Generator, Model 275 Type B, provides precision time signals (Days, Hours, Minutes, Seconds) in conformance with IRIG (Inter-Range Instrumentation Group) Recommendation No. 104-60, Formats B and C. Model 275 Types A and C, generate similar signals for other data recording and computer applications.

The chart (below) shows the types of time code data available and the seven forms of output presentation. Typical applications are illustrated.

FORMS OF OUTPUT PRESENTATION	TYPES OF DATA PRESENTED			TYPICAL APPLICATIONS	
	30 bit 100 pps	28 bit 2 pps	42 bit each ms		
(Serial) AM on 1 kc/s Carrier, 3-to-1 ratio	✓			High Speed Analog Tape Recorder	⊕
(Serial) AM on 100cps carrier, 3-to-1 ratio		✓		Tape Recorders with speeds less than 7 1/2 ips	⊕
(Serial) D-C Pulse Width Code	✓	✓		Oscillograph	⊕
(Serial) Neon Driver	✓	✓		Data Recording Cameras	⊕
Parallel BCD			✓	Digital Acquisition Systems	⊕

Pulse repetition rates of 1pps, 10pps, 100pps and 1,000pps are also provided.

The seven outputs of the Model 275 (6 serial, 1 parallel) are based on a built-in precision oscillator which is stable to 1 part in 10^8 per day. For those applications requiring even greater stability, the Hermes Ultra Stable Oscillator, Model 105A* may be switched in as an external frequency source. Circuits for automatic WWV synchronization with time preset are included. Also provided is a front panel Visual Decimal Display, synchronized with the output signals.

*Stable to 5 parts in 10^{10} per day!

Write for Technical Bulletin 275

Hermes



ELECTRONICS CO.

75 CAMBRIDGE PARKWAY, CAMBRIDGE 42, MASS.

A DIVISION OF

Itek

CIRCLE 38 ON READER-SERVICE CARD

MIL-SPEC One-Turn Pots

Precision wire-wound potentiometers, Series 42BM and 42CM, meeting the applicable sections of MIL-R-19, -12934, -19518 and NAS-710, are designed to con-

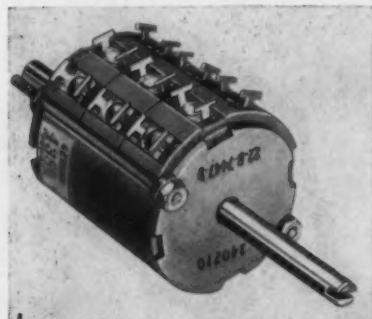


FIG. 1. SINGLE-TURN precision wirewound pots up to 20 gangs are available in the 42BM and 42CM Series.

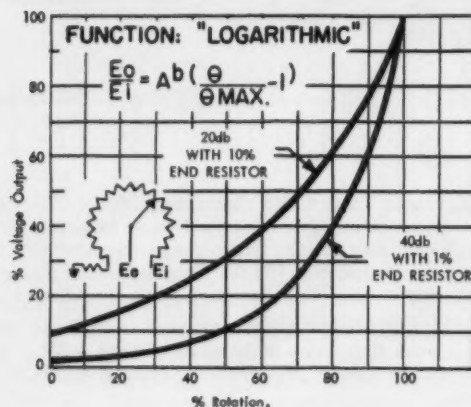


FIG. 2. LOGARITHMIC function output curve is typical of non-linear outputs in new wirewound pots. Log, sine-cosine and square law are other typical types with irregular functions available to satisfy "tailor made" requests.

Connections Unlimited

New subminiature "Cross Patch" patch cords having positive, lasting contact for banana plugs on top side, interconnects an unlimited number of multiple circuits. Overall length of plug only $\frac{3}{4}$ " with molded plastic handle available in choice of ten colors. Subminiature "Cross Patch" banana plug springs are (0.275" long) four-leaved beryllium copper, silver plated.

"Cross Patch" cords are designed for general purpose use where operating voltage does not exceed 300 v rms, in temperatures from -40° to 105°C . Connecting wire is 22 AWG 150/44 having 19 ohms maximum resistance per 1000 ft at 68°F . Standard patch cord lengths are 6", 12", 18" and 24" but can be furnished to special lengths on request.

"Cross Patch" plugs and cords of standard size and in dual plug configurations are also listed. (From

trol from 1 to 20 circuits simultaneously. They are readily adaptable for many applications in close tolerance, high performance assemblies in servo-mechanisms, range-finders, fire control systems and calculating devices.

Available in non-linear as well as linear functions (Fig. 2) and with up to 8 taps on special order, the

SPECIFICATIONS: Series 424BM or 42 CM Pots

Feature	Unit	Std.	Special
Max. Resistance*	Ω	100K	100K
Res. Tolerance	%	± 5	± 1
Linearity Δ	%	± 1	± 1.5
Non Linear Output	$\Omega/\text{Degree Max.}$	350	350
Power \square Dissipation	Watts @ 40°C	3	5**
Resolution	Max. %	Dependent Resistance & Temp. Coeff. & Eff. Rot.	
Life*	Max. Cycles	250,000	1,000,000
Ambient Temp.	Max. $^{\circ}\text{C}$	105	200**
Gangs	Max. No.	20	20
Rotor Inertia	Approx. gmcm ² Per Wiper		4.4
Torque	Oz. In. Max. Per Cup	1.0	.5 Min. to 20 Max.
Taps	42C 42B	1 Up to 5	1 Up to 8
Speed of Rot.	R.P.M. Max.	90	90
Mounting	Type	Bushing	Servo & Stud Mfg.

* Depends upon design parameters.

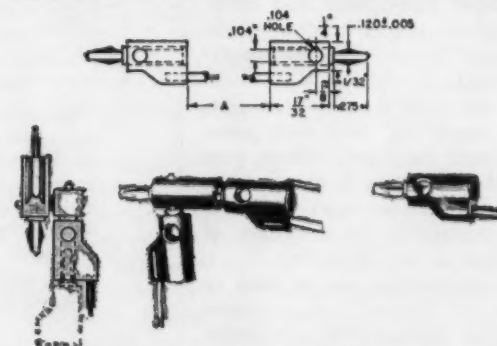
Δ Dependent on total resistance, effective rotation and temperature coefficient.

\square Derated to zero power @ 105°C .

** By modification and upgrading of materials, standard specifications can be excluded. Submit specifications.

series has been designed purposely for modification versatility. This versatility is further enhanced by the fact that it can be supplied in either continuous or limited rotation. (From 12-page catalog section 1, EEM 4700, Clarostat Mfg. Co., Inc., Dover, N. H.)

FOR MORE INFORMATION CIRCLE 126 ON READER-SERVICE CARD



60-page catalog No. 61 of Smith Electronic Components including clips, plugs, terminals, switches, fastenings and handles.—Herman H. Smith, Inc., 2326 Nostrand Ave., Brooklyn 10, N. Y.

FOR MORE INFORMATION CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION CIRCLE 128 ON READER-SERVICE CARD

RF Tone Generator Speeds SSB Distortion Checks



FIG. 1. TWO-TONE GENERATOR, TTG-5, used with any AF Spectrum Analyzer gives quick visual analysis of distortion and hum sidebands of any single-sideband receiver. Single and dual tones are also valuable in receiver gain measurements, AGC analysis and as an exciter in testing RF power amplifiers.

Distortion testing and adjustment of single sideband receivers becomes a direct and simple process using the new TTG-5 Dual RF Tone Generator (Fig. 1). To make a check for distortion on a typical receiver, its audio output is connected to any audio frequency spectrum analyzer such as the Panoramic Model LP-1a or the extended range (100 cps—40 mc) SSB-3a Single Sideband Analyzer (Fig. 2). The TTG-5 dual signal is fed into the antenna input of the receiver.

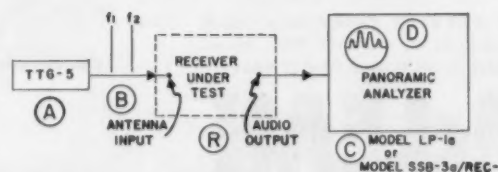


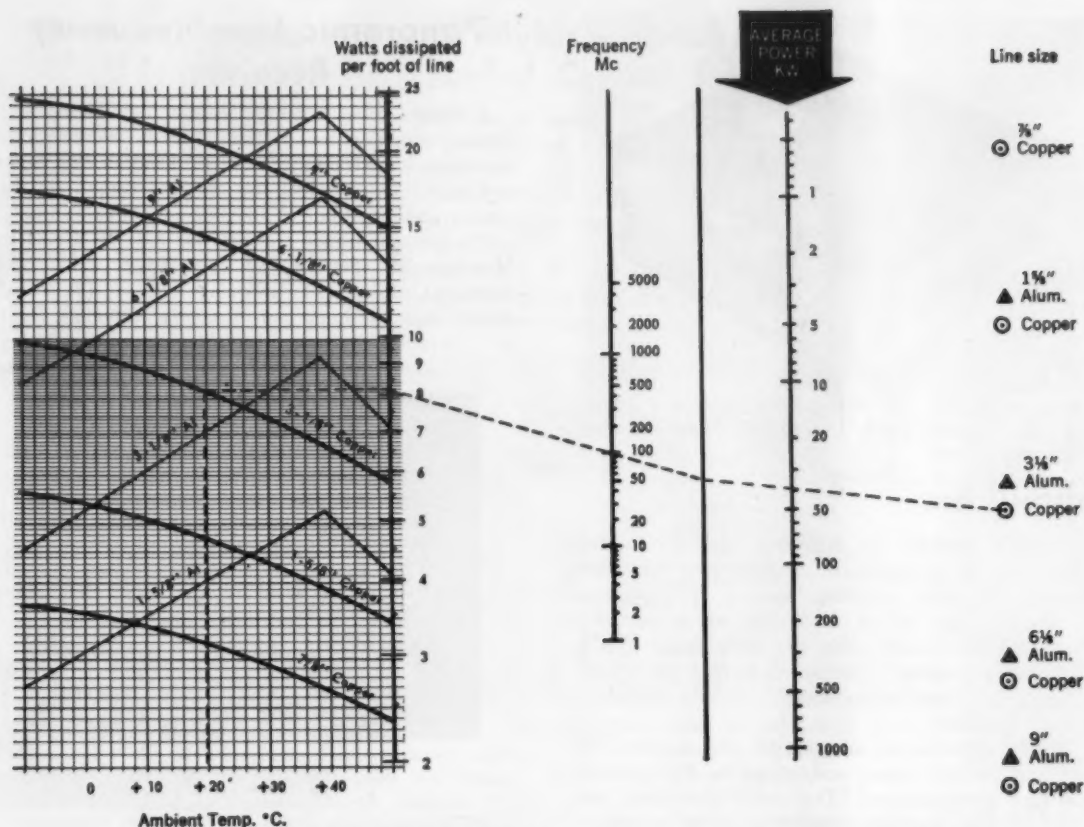
FIG. 2. BLOCK DIAGRAM of Typical Test of Single Sideband Receiver. Two Tones plus unwanted distortion components are displayed on Analyzer CRT.

The two tones, f_1 and f_2 , will be displayed on the CRT of the spectrum analyzer with the two desired tones prominently shown, along with any distortion present such as in-band third order components. As adjustments are made on the receiver the effects on the distortion are instantly apparent.

The TTG-5 furnishes five pairs of virtually distortion-free crystal-controlled RF signals in the 3-30mc range. Frequency differences between the tones of each pair are adjustable from 0 to 0.0% of mean frequency. The metered TTG-5 output level is 0.1 v rms for each tone @ 50 ohms with 0 to 100 db of attention with 0 to 100 db of attenuation provided in 1db steps.

The output of the receiver is then fed into the spectrum analyzer.

The combination of the Model SSB-3a Single Sideband Spectrum Analyzer with the REC-1 Range Extending Converter permits analysis of signals down to 100 cps and for frequencies up to 40 mc. The TTG-5 and associated instruments are developments of the Panoramic Radio Products Inc., 520 South Fulton Ave., Mount Vernon, N. Y.



Ambient Temp. °C.

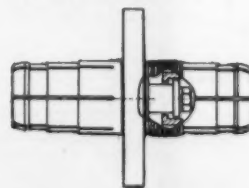
FIG. 1. POWER RATING NOMOGRAM. Average permissible power per 20-ft lengths of TACO Rigid Aluminum and Copper Coaxial Lines is quickly computed by this nomogram. In the example shown, 3 1/8" copper line for 100 mc at an ambient temperature of 20°C gives a maximum permissible dissipated power of 8.3 watts/ft and an average power of 40 KW.

Power Nomogram for Rigid Coax

Average power in any rigid coaxial line is limited by the temperature rise of the center conductor and the expansion differential between the center conductor and the outer conductor. The nomogram (Fig. 1) is based on unpressurized 20-ft line sections with Taco standard inner connectors. Maximum center conductor temperature is 100°C, well within the safety limits of Teflon. Average permissible power can be increased if Taco bellows inner connectors (Fig. 2) are used to provide more expansion of the center conductor without deforming. The bellows connector is also important in receiving lines where it eliminates noise generated by the center conductor sliding over the connector.

In the example given, a 3 1/8" copper line is operated at 100 mc at an ambient temperature of 20°C. From the graph at the left of Fig. 1 a value of 8.3 watts dissipated per foot of the line is found on the vertical scale opposite the intersection of the 20°C ordinate with the 3 1/8" copper line.

The point on the watts dissipation/ft line is now drawn to the frequency line at 100 mc and extended to intersect the index line. This intersection is then connected by a straight line to the appropriate size-material symbol, in this case 3 1/8" copper. Maximum



permissible average power in kw is then read directly.

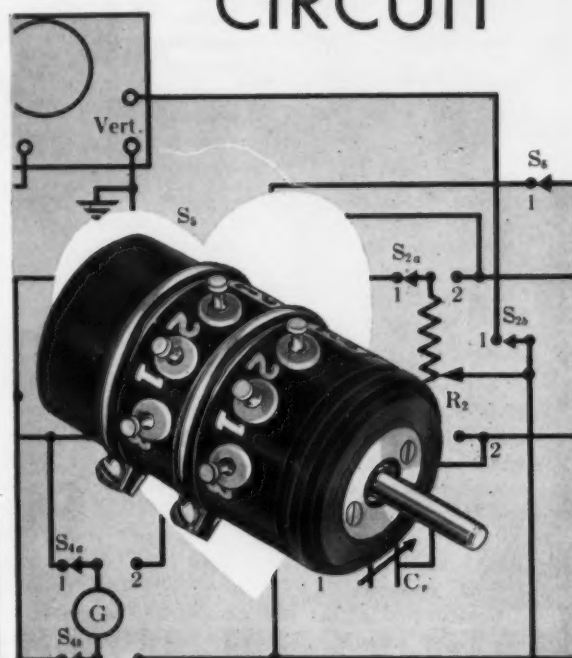
Peak power depends on a number of factors. Nominal peak power, as given in Taco specification tables, are for an unpressurized line with no modulation and unity VSWR, including a voltage safety factor of 2. For any other condition use the following formula:

$$P_{pk} = \frac{4 P_o D p (VSWR)^2}{(1 + M)^2 (1 + VSWR)^2}$$

Where P_o is the nominal peak power from specifications, D is electrical strength of pressurizing medium relative to dry air, p is line pressure relative to one atmosphere, M is degree of modulation and VSWR is standing wave ratio, (From new 10-page Catalog 200, Technical Appliance Corp., Sherburne, N. Y.)

FOR MORE INFORMATION CIRCLE 129 ON READER-SERVICE CARD

HEART OF THE CIRCUIT



PRECISION POTENTIOMETERS

by New England Instrument

WIRE WOUND — CONDUCTIVE PLASTIC

Whatever your potentiometer requirement may be, N.E.I. has the answer. Since we produce both wire wound and conductive plastic types our engineers can impartially evaluate your problem and come up with the proper solution.

CONDUCTIVE PLASTIC

- Infinite resolution
- Unsurpassed reliability
- Negligible noise level
- Standard resistance values 1K, 2K, 5K, 10K and 20K, 0.5 linearity.
- Specials from 500 ohms to 1 megohm — 0.1% linearity
- Single or multigang construction.

WIRE WOUND

- Meet performance specs of MIL5272A, and NAS710 and applicable portions of JANR-19
- Maintain excellent characteristics from -55° to 150°C
- Available from 1/2" single and 10 turn types to 3"
- Standard resistances from 1K to 100K, special designs from 25 ohm to 250K
- Single or multigang construction.



SEND FOR COMPLETE CATALOG

New England Instrument Company

39 Green Street, Waltham, Massachusetts

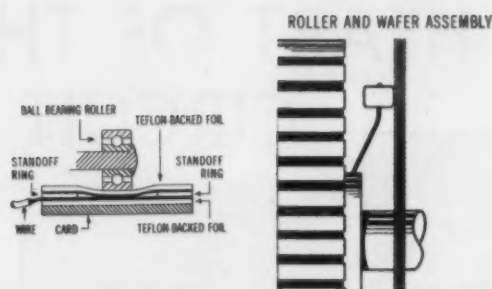


FIG. 1. TEFLON-BACKED Gold foils make noiseless contact in new commutator switch. Cross section (left) shows foil diaphragm depressed by bearing. Right-hand view shows drive gear and roller assembly.

Low-Noise Commutator

A new commutator (designed for rocket and satellite telemetry) has so successfully diminished contact noise that amplification stages prior to commutation can be eliminated. Developed through extensive research in low noise contact problems, the new Rotoflex® has a noise level guaranteed less than 10 μ v (the lower limit of present noise tests), at 1 kc bandwidth under 1000 ohms load in the range of 6 v to 50 μ v.

Construction of the new commutator is shown in Fig. 1. The capsule wafer consists of a gold-foil contact diaphragm with a Teflon-impregnated backing separated from the channel segments (also of precious metal) by two concentric stand-off rings. All components are sealed together in a unit which is free from dust, moisture and other environmental factors.

Contact between the segments and the contact diaphragm is accomplished by depressing the teflon-backed foil with a rolling bearing. The pressure of the bearing creates a dimple which makes a highly reliable contact with negligible noise. Typical high speed sampling rates are 3 to 600 per second, either in "break-before-make" or "make-before-break" operation.

Thirty channels of information are standard for the unit but by adding wafers, up to 300 channels may be accommodated. The solid aluminum case (Fig. 2) also encloses a size 9 v dc 27 motor. A 27 v, 400 cps synchronous motor is an optional choice. All connectors are standard self-contained units. (From new 4-page Model 6-15 brochure, Technology Instrument Corporation of Acton, Space Instrumentation Division, 533 Main St., Acton, Mass.)

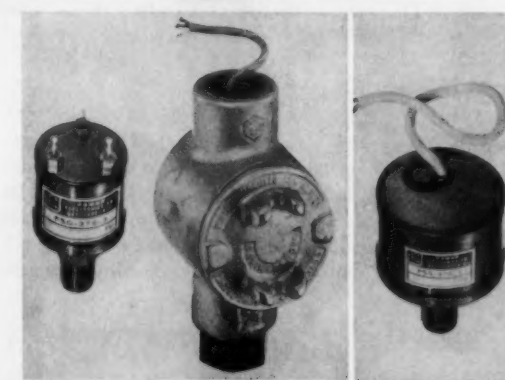
FOR MORE INFORMATION CIRCLE 130 ON READER-SERVICE CARD

Pressure Switch Features Ruggedness, Simple Construction

Only one moving part, a NI SPAN C capsular type sensing element, is used in an aluminum, or stainless steel housing to provide a one-ounce pressure actuated switch capable of withstanding extreme shock and vibration yet guaranteeing a repeatable accuracy of $\pm 0.5\%$.

The actuation setting is fully adjustable throughout the operating range without removing the unit from the installation and while the system is in full, normal operation. Setting the pressure switch to the desired pressure point is done by simply loosening the locknut on the fitting and turning the housing clockwise to lower the set point and counter-clockwise to raise it.

The basic model with solder terminals and with attached insulated cabled leads is shown in the figure. The switch is a snap-action SPDT switch rated from 6 amps @ 115/230 v ac. Actuation settings from 1/2 psig to 500 psig are available, also low pressure types having a max setting of 7 psig and a dead



band of 4" H₂O. All pressure ranges and connector styles may be furnished in Crouse-Hinds Explosion-proof housings.—(From 4-page Brochure, Pamar Electronics Company, Inc., 1 Tenakill Park, Cresskill, N. J.)

FOR MORE INFORMATION CIRCLE 131 ON READER-SERVICE CARD

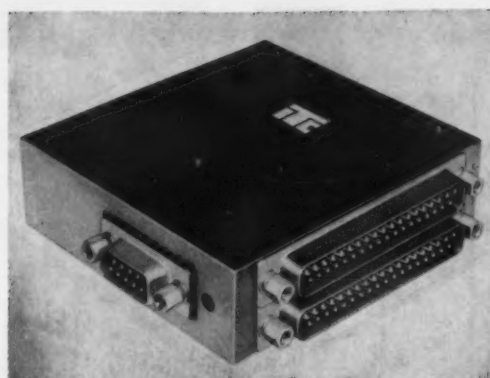


FIG. 2. THIRTY channels of information are standard but by adding wafers up to 300 channels can be accommodated.

Panoramic Low-Frequency Receiver

A tireless robot watchdog is now monitoring electromagnetic radiations in the 50 cps to 100 kc range, continuously sweeping any 10 kc band in this range and faithfully recording the received signals by frequency and amplitude in any one-minute exposure.

The new panoramic receiver, the AN/URM-126, by Motorola, is composed of four basic units: (1) Antenna Coupler; (2) Panoramic Display; (3) Power Supply and (4) Loop and Monopole Antennas. Built-in Calibration signals can be switched into the display.

The Panoramic Display Unit is a double-conversion

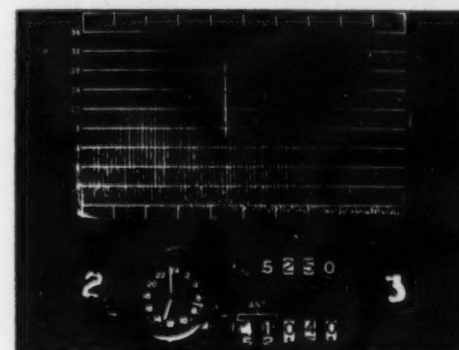
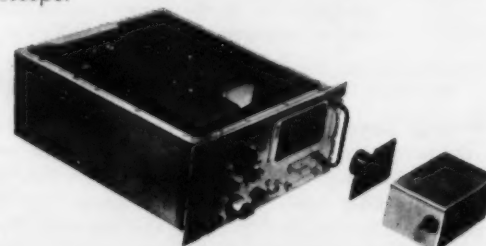


FIG. 1. SIGNALS spaced only 15 cps apart in frequency are sharply defined in new panoramic recording receiver. An industrial noise environment record here displays 60 cps power line frequency components.

FIG. 2. CAMERA and film magazine are readily removed for direct observation of the cathode ray oscilloscope.



superhetrodyne receiver that displays on a high-resolution CRT a calibration signals, a received signal, or both. Easy determination of frequency and amplitude is made by reference to a lighted, cross-hatched graticule on the CRT face (Fig. 1). Calibration scale factor, local time and the date are recorded simultaneously on each film frame.

The Camera Section of the Display unit is designed to be completely automatic although it can also be manually operated. The number of sweeps per exposure as well as the time between exposures are adjustable. Mounted on the front panel for easy access, the camera magazine can be removed for direction observation of the CRT. (Fig. 2) The magazine holds up to 100 feet of 35mm film allowing for up to 1200 hours of unattended operation. (From 4-page brochure, "Low Frequency Systems Capabilities," Motorola, Inc., Military Electronics Division, Scottsdale, Ariz.)

FOR MORE INFORMATION CIRCLE 132 ON READER-SERVICE CARD

Suppress
lead wire
errors
with

REC's new

TRIPLE BRIDGE UNIT

Check these advantages in resistance temperature measurement applications:

- Suppresses large lead resistance changes (up to 5 ohms)
- Suppresses variable lead resistances at null and when unbalanced
- Suppresses unequal lead resistances
- Trims out calibration differences
- Multiple temperature ranges
- Standardized 10 mv. DC output
- Full line of auxiliary equipment

This precision-made, plug-in unit permits convenient change of full-scale temperature and corrects known calibration errors of sensor. Basic 10-channel unit provides 10 temperature ranges for each of 10 sensors.

Write for Bulletin 86012



**ROSEMOUNT
ENGINEERING
COMPANY**

4900 West 78th Street, Minneapolis 24, Minnesota
CIRCLE 40 ON READER-SERVICE CARD

Surface temperatures
within $\pm 0.2^\circ \text{F}$!



A+ THERMOPHIL thermistor Resistance Thermometer

- every probe built to specifications with compensating network; fully interchangeable
- spring-mounted tip for constant surface pressure
- calibration allows for heat loss up probe shank
- full reproducibility
- battery or AC powered

\$246.00 as illustrated
Write for Bulletin

A+ ATKINS TECHNICAL INC.
1276 W. Third St.
Cleveland 13, Ohio
temperature and
humidity instrumentation

CIRCLE 41 ON READER-SERVICE CARD

May-June, 1961

Mylar Capacitors in Sealed Crystal Type Cases

Hermetically sealed mylar-dielectric capacitors are now available in readily-mounted crystal style and plug-in cases from the Southern Electronics Corp., Burbank, Calif. (Fig. 1). Crystal type capacitors have either wire or pin-type leads in capacities from .10 to .68 μf , while the plug-in types cover capacities from .001 to 5.0 μf . Voltage ratings from 100 to 300v are standard, derating 50% from 85° to 125°C . Operating temperature range is from -55° to 125°C .

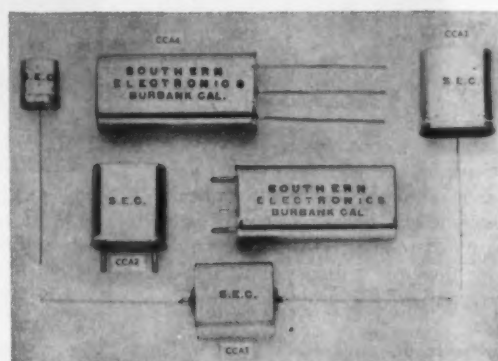


FIG. 1. MYLAR-DIELECTRIC capacitors in hermetically-sealed crystal style and plug-in cases provide medium-voltage capacities in minimum volume.

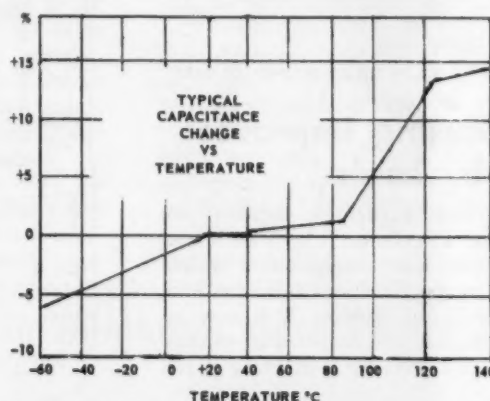
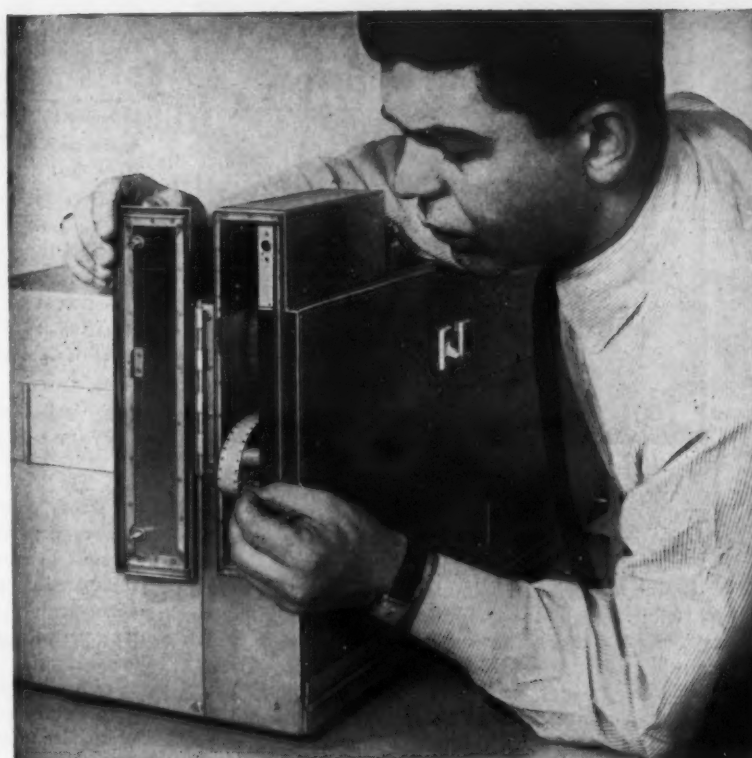


FIG. 2. RISING TEMPERATURE-capacitance characteristic of Mylar Dielectric capacitors.

Mylar dielectric capacitors show a decreasing insulation resistance characteristic with temperature, but an increase in capacitance with temperature (Fig. 2). A typical .10 μf 300 v crystal case Type CCA capacitor is only .750" x .717" x .312". Dissipation factor of the Mylar dielectric capacitor is at a minimum from 25° to 65°C , being approximately .6 over that range. Standard tolerance is $\pm 10\%$ of indicated capacity, but can be furnished as low as $\pm 1\%$. The capacitors will withstand storage in ambients from -65° to 150°C .— (From 24-page catalog, "Precision Plastic Capacitors," covering polystyrene, Mylar and Teflon capacitors.—Southern Electronics Corp., 150 West Cypress Ave., Burbank, Calif.)

FOR MORE INFORMATION CIRCLE 133 ON READER-SERVICE CARD



MINI-RAPID PROCESSOR DEVELOPS DATA DISPLAY FILM RECORDS—FAST!

See your data display film records in minutes. Fairchild Mini-Rapid Film Processors give you automatic delivery of negatives — developed, fixed, washed, dried — commercial quality.

16mm films up to 6 f.p.m.

35mm films up to 4 f.p.m.

Oscillograms, digital or analog display, radar, meters, gauges, controls — any information display that you record on 35 or 16mm film can be read back just a few minutes after your film is inserted into the Mini-Rapid.

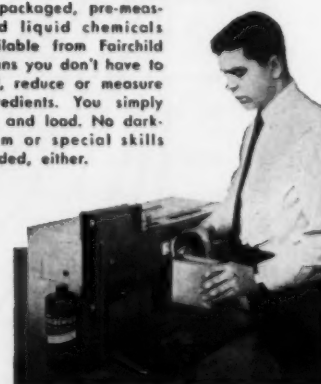
Operation? Easy. Insert a few inches of film into the loading compartment, drop in spool, close door. Automatic transport takes over and does the rest.

Write for illustrated specifications and prices to Industrial Products Division, Dept. MS-6, Fairchild Camera and Instrument Corp., 580 Midland Ave., Yonkers, N. Y.

MINI-RAPID FEATURES

- capacity up to 400 feet
- table top compactness
- dual thermostat control
- completely automatic
- leaderless daylight loading
- self-threading film transport

Pre-packaged, pre-measured liquid chemicals available from Fairchild means you don't have to add, reduce or measure ingredients. You simply mix and load. No dark-room or special skills needed, either.



INDUSTRIAL PRODUCTS DIVISION
FAIRCHILD
CAMERA AND INSTRUMENT
CORPORATION

CIRCLE 42 ON READER-SERVICE CARD

Infrared Reflecting and Transmitting Glasses

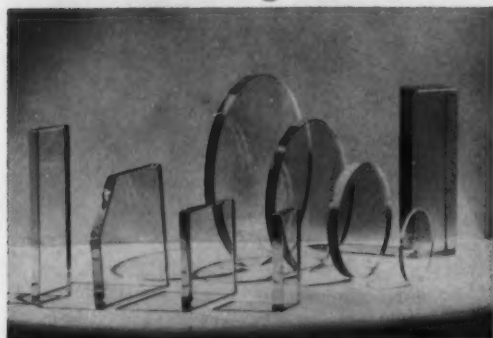


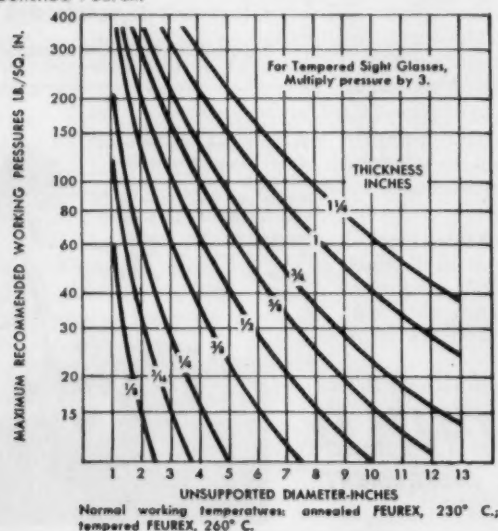
FIG. 1. HEAT TRANSMITTING Feurex Glass is a borosilicate glass with superior heat-resistant characteristics. It is available in rectangular and circular shapes, in rolled or ground and polished surfaces.

Feurex Borosilicate Glass is not only transparent to visible light but also transmits the short infrared rays and the near ultraviolet rays as well. It is good material for transmitting infrared radiations from comparatively high temperature sources.

Other characteristics of Feurex glass compared to lime glass are shown in the accompanying table. Feurex is available in annealed forms for high temperature applications and in tempered form where high mechanical strength rather than high thermal strength is important. Sheets in rectangular and circular sized, with rolled surfaces or ground and polished for high optical accuracy are also available (Fig. 1).

When used as a sight glass in a pressure vessel, the thickness of Feurex Glass should be governed by any hydrostatic test to which the vessel will be submitted (Fig. 2). The method of mounting the glass is of great importance and should be designed to minimize physi-

FIG. 2. RECOMMENDED WORKING PRESSURES, Annealed-flat circular sight glasses of ground and polished Feurex.



Physical property	Ordinary Lime Glass	FEUREX Brand Glass
Softening Point, °C.	696	820
Annealing Point, °C.	510	555
Strain Point, °C.	470	510
Maximum Operating Temp. °C.	460	490
Specific Gravity (gm/cc)	2.47	2.23
Refractive Index (nD)	1.512	1.474
Electric Resistivity (ohms-cm)		
Log 10R at 250° C.	6.4	12.0
Log 10R at 350° C.	5.1	9.7
Dielectric Constant (20° C.)	7.2	3.8
Power Factor	.9	0.0046
Linear Coeff. Expansion (per °C. x 10 ⁻⁷)	92	35.5

cal stress concentrations in the glass. Any thermal stresses present combine additively with mechanical stresses. Feurex Glass, however, has a low coefficient of expansion, making its thermal stresses for any operating condition lower than for ordinary lime glass, thus permitting correspondingly greater mechanical loads.

Infrared Reflecting Glass, in thicknesses from 1/8" to 1/4" and in circles or rectangles, is also available cut to size. Facilities for processing odd shapes and sizes of heat resisting glass are also available to customer specifications.—(From 12-page catalog, "Heat Resisting Flat Glass, Kaufman Glass Company, 1209-21 French St., Wilmington, Del.)

FOR MORE INFORMATION CIRCLE 134 ON READER-SERVICE CARD

Optical Focusing Improves Ruby Laser

One-tenth the power formerly required to achieve laser action in a synthetic ruby is sufficient to operate a new pulse laser configuration which has been developed by the Raytheon Research and Microwave & Power Tube Division. It is now in production to meet the demand by research experimenters and commercial users for a practical pulse laser.

Previous designs have used a helical xenon flash tube surrounding the cylindrical synthetic ruby to stimulate it to laser action. This configuration wasted much of the stimulating energy from the flash tube.

In the new design (Fig. 1) a pencil-like xenon tube, about five inches long and only one-quarter inch in diameter, is placed at one end of the two foci in a cylindrical cylinder of elliptical cross section. The synthetic ruby is placed at the other focus. The inner surface of the cylinder is silvered to form a first-surface mirror. All the light emitted from the xenon tube is concentrated on the ruby.

Only 200 joules of input power are required to produce laser action of about 100 μsec duration. Using a helical flash tube in earlier experiments, more than 2000 joules was needed to produce laser action of the same duration. The schematic circuit



FIG. 1. RUBY PULSE LASER using less than one-tenth of power formerly required is now available as experimental tool. Ruby rod, center, and pencil-shaped flash tube, below, are positioned on focus lines of elliptical reflector, conserving pumping energy.

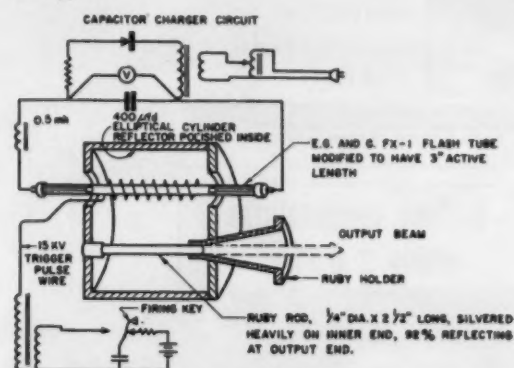


FIG. 2. LASER SCHEMATIC is straightforward. Chromium atoms in the ruby rod are excited to higher energy levels by a pulse of light from the flash tube. The chromium atoms returning to the ground state emit coherent light.

shown in Fig. 2 is used to fire the xenon tube, a type FX1 (made by Edgerton, Germeshausen & Grier, Inc.).

The synthetic ruby being used in Raytheon's laser is the conventional type—aluminum oxide with 0.05% chromium.

Using the new laser, Raytheon scientists have been able to observe pulse structures which had been predicted earlier through experiments with the firm's maser. They predict that the new development may speed accomplishment of a CW laser with its highly desired continuous light beam.

Additional information on outputs and operation of the Model LH-1 Laser Head and LPS-1 Laser Power Supply will be supplied on request to Special Microwave Device Operations, Raytheon Company, 130 Second Ave., Waltham 54, Mass.

FOR MORE INFORMATION CIRCLE 135 ON READER-SERVICE CARD

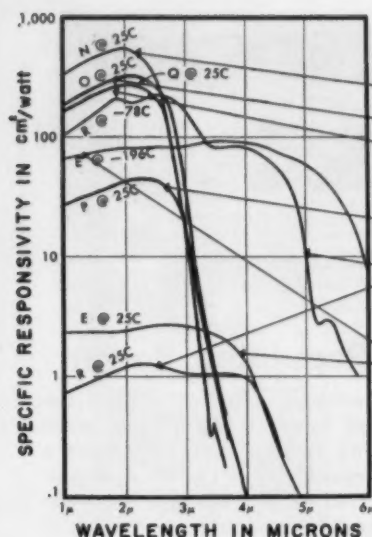


FIG. 1. SPECIFIC RESPONSIVITY of Ektron detectors is determined by type of photoconductive material and cover media used.

Photoresistive Detector Arrays

An Ektron Detector is essentially a film of photoconductive substance deposited on a glass or quartz base. Changes in irradiance produce changes in the resistance of the film which may be observed as an electrical signal.

The Ektron detector acts as a pure Ohm's law resistor, with no diode effect. It is not subject to microphonics. The sensitive area may have almost any size or shape.

To tungsten illumination, the Ektron detector has roughly the same order of response as emissive type phototubes of the same sensitive area. However, maximum sensitivity is attained in the infrared (Fig. 1).

FOR MORE INFORMATION CIRCLE 136 ON READER-SERVICE CARD

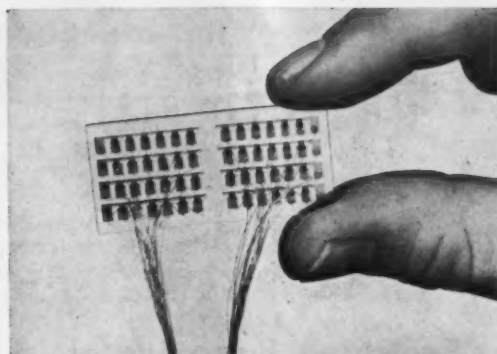


FIG. 2. EKTRON detectors are available in many forms, as single or multiple elements. Mosaic array, to give faster data readouts on computers, is shown.

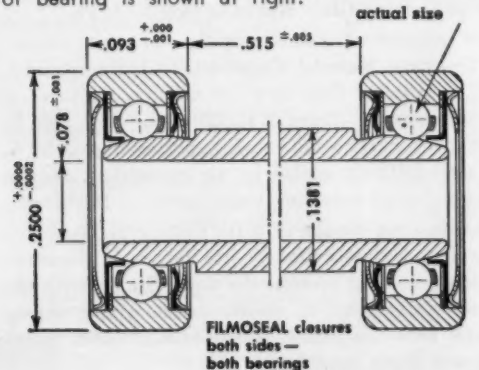
Lamps to actuate it may therefore be operated below incandescence for long service life. Even more important, are its uses as an infrared sensor in weapons systems and in instrumentation for process control, analysis and safety.

In physical form, Ektron detectors are available as round plug-in cells, as a rectangular surface on unmounted 0.030" glass with gold electrodes, as multiple detector elements in linear arrays or mosaics (Fig. 2), as a detector film deposited directly on the plano surface of a hemispheric lens of 2.5 to 13 mm radius and as mounted in a dewar housing with provision for inserting refrigerant or cryostat.

Cooling has large effects in raising signal to noise ratio, increasing resistance, increasing time constant and extending spectral range of sensitivity. (From 4-page bulletin, "Kodak Ektron Detectors for the Infrared", Eastman Kodak Co., Special Products Sales Div., Rochester 4, N. Y.)

Bearings for Miniature Gyro Rotors

CAPILLARY type seal for miniature gyro bearings can be removed for cleaning of bearing and reinstalled. Actual size of bearing is shown at right.



FOR MORE INFORMATION CIRCLE 137 ON READER-SERVICE CARD

Special rotor bearings designed specifically for miniature gyroscope applications include both bearings and the shaft (See figure). Filmoseal closures insure lubrication and long life without mechanical contact or an increase in assembly width. This closure, a development of RMB miniature Ball Bearings, is a capillary type seal for low torque miniature instruments and instrument ball bearings. It can be removed for cleaning of the bearing and can be reinstalled.

The G-23 type bearing assembly shown has two-piece ribbon type ball retainers, ideally suited for high speed rotors. Manufacturing tolerances are within ABEC-7 except bore and O. D. which are ABEC-5 to permit selective assembly. (From 16-page catalog, RMB Miniature Bearings, Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y.)

Response-ability!

PLUS REDUCED
SIZE AND
WEIGHT



EAD 60 CYCLE MINIATURE SERVOMOTORS

Design instant response into your recording instruments and, at the same time, miniaturize your "package" with substantial cost-reductions. EAD 60 cycle, size 15 miniature servomotors are engineered for RESPONSE-ability...the ability to produce rapid acceleration and reversing without over-power and over-size.

These 60 cycle, size 15 servomotors, now available for commercial applications, have the same precision RESPONSE-ability as EAD's military versions...your assurance of high performance and reliability.

TYPICAL PERFORMANCE DATA

MODEL	S2HBZ7-A	S2HAX7-A
Voltage	115 volts	115 volts
Frequency	60 cycles	60 cycles
Stall Power/Phase	6.0 watts	6.0 watts
Stall Current/Phase	70 MA	70 MA
Time Constant	.0052 Sec.	.00915 Sec.
Reversing Time	.0089 Sec.	.0155 Sec.
Rotor Inertia	4.0 gm cm ²	3.3 gm cm ²
No Load Speed	1500 RPM	3000 RPM
Stall Torque	1.7 oz-in	1.6 oz-in

*Basic models. Mechanical modifications available to customer requirements.

If your responsibility is improved recorder design, look first to EAD for the servomotor line that meets all your RESPONSE-ability requirements. Call your nearest EAD representative or write about your specific needs.

Rotation is A Science At
EASTERN AIR DEVICES, Inc.
A SUBSIDIARY OF NORBUTE CORPORATION
345 Central Ave., Dover, New Hampshire
CIRCLE 43 ON READER-SERVICE CARD

ALL DIGITS
CAN BE
READ FROM
ANY ANGLE

IN-LINE DIGITAL READOUT

featuring
ONE-PLANE PRESENTATION
Series 10000



The IEE digital readout puts the digit right up front, visible from any angle. Vision is unimpaired by stacked characters and sharp, clear-white digits provide high-contrast, error-proof reading. Use of words, color, and multiple projections offer utmost versatility.

Binary-To-Decimal Decoders Available.
Representatives in Principal Cities

Over 1000
firms throughout
the world in just a
few years prove
unprecedented
acceptance of
IEE digital
readouts.

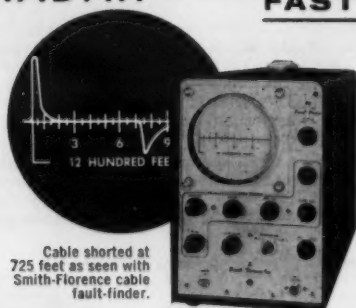
PRICE **\$1800**
COMPLETE
QUANTITY PRICES ON REQUEST
WRITE TODAY FOR
COMPLETE SPECIFICATIONS.



INDUSTRIAL ELECTRONIC ENGINEERS, INC.
Engineers and Manufacturers of Fully Automatic Systems and Digital Readouts
5528 Vineland Avenue, North Hollywood, California

CIRCLE 44 ON READER-SERVICE CARD

Cable Faults? RADAR FINDS THEM FASTER



Cable shorted at
725 feet as seen with
Smith-Florence cable
fault-finder.

SMITH-FLORENCE electronic fault-finders speedily solve electrical cable servicing problems by giving you a "picture" of exactly where the trouble is and what it is. Using the radar principle, these dependable S-F instruments permit accurate ranging from only one end of the cable to pinpoint shorts and open circuits. S-F offers a variety of models with ranges from 200 feet to 100 miles for servicing in missiles, aircraft, ships, industrial plants and communication systems. Prices: \$375 to \$695.

Get more details—including how you can use S-F fault-finders for other important jobs—by writing to:

SMITH-FLORENCE INC.

4228 TWENTY-THIRD AVENUE WEST, SEATTLE 99, WASHINGTON

CIRCLE 45 ON READER-SERVICE CARD

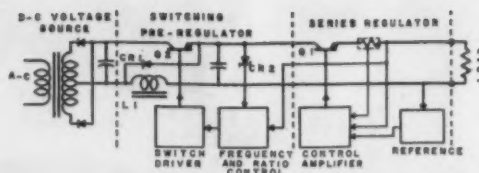


FIG. 1. SWITCHING Preregulator is combined with series regulator in a new type of power supply giving practically lossless regulation to 0.1 volt.

Switching Preregulator is Key to Efficient Regulated Power

A switching preregulator offers essentially lossless regulation to within 0.1 v. It regulates against all changes in line voltage and load changes so that the series regulator driven by this preregulator may operate at low constant voltage and therefore at high efficiency.

Although the principles employed in switching type power supplies have been used for years, (e. g., the familiar automobile current regulator), recent solid-state developments and refined control circuitry have made possible more sophisticated power supplies.

In order to design a power supply having line and load regulation in the neighborhood of 1 mv, transient response under 50 mv, and having reasonable efficiency at high currents, there is currently no known substitute for the high-gain series-regulating-type circuit. However, vacuum tube type series regulated power supplies have efficiencies from 30% to 40%, and conventional transistorized series regulating power supplies typically have 50% efficiency or less. The reason for this low efficiency, is that to provide sufficient voltage across the series regulating element for all combinations of high and low voltage, input ripple and load transients; the power supply must be physically large to provide the necessary heat sink.



FIG. 2. REGULATED power supply with efficiency of 80% and more is rated at 36 v 10 amperes with 0.01% regulation.

The ultimate in power supply efficiency and performance may be achieved by combining a single power supply a high-efficiency switching preregulator and a conventional series regulator (Fig. 1). The preregulator circuit is referenced to the output of the series regulator as its control voltage. A two-volt offset is added to this control voltage by including zener diode CR2 in the comparator circuit, which enables the preregulator to maintain just enough voltage across the series regulator at maximum load values to retain the control.

Since the preregulator is referenced to the output voltage, the drop across the series element will remain essentially constant, independent of whatever voltage the output is set. Efficiencies of 80% and more may be obtained in a power supply of this type, along with current ratings up to 30 amperes (Fig. 2). Because the problems of heat radiation are virtually eliminated extreme packaging economies are achieved. Even under short circuit conditions the current can rise only to the preset maximum. There is no increase of internal dissipation under overload or shortcircuit conditions. (From 16-page Catalog PS 361, Valor Instruments, Inc., 13214 Grenshaw, Gardena, Calif.)

FOR MORE INFORMATION CIRCLE 138 ON READER-SERVICE CARD

Massive Glass Resistors for Project Mercury

Glass resistors as big around as telephone poles will be used in point-to-point communications between



Project MERCURY tracking stations.

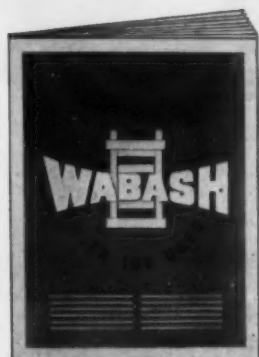
The four-foot long units, (see Figure) serving as dummy antenna loads for testing and calibrating transmitters and as power dissipating terminations for rhombic and other transmitting antennas, were produced by Corning Electronic Components, a department of Corning Glass Works at Bradford, Pa.

The resistors were chosen by the equipment designers, Technical Materiel Corporation of Mamaroneck, N. Y., because of their very low uniform reactance at high frequencies (from 2 to 28 mc). They can be brought instantly to full rated output even at -40°C , and are effectively cooled by air convection, even at maximum rated operating temperature of 100°C .

The resistors consist of a tin oxide film fused into Pyrex brand glass cylinders five inches in diameter. A silicone coating protects the unit. The resistive elements were spiraled to obtain specific ohmic values, uniform heat dissipation, and minimum series inductance and shunt capacitance.

FOR MORE INFORMATION CIRCLE 105 ON READER-SERVICE CARD

Here Is Your New Wabash Hydraulic Laboratory Press Catalog!



Covers the most complete line and the most soundly engineered hydraulic presses in the field. Models from 12-ton to 100-ton capacity. For tests or small production runs involving compression, crushing, forming, molding, laminating, imbedding, etc. Platen electrically heated. Manually operated and motorized models. Send for your copy today, giving your title.

WABASH METAL PRODUCTS COMPANY

1516 Morris Street
WABASH • INDIANA

CIRCLE 46 ON READER-SERVICE CARD

NORTH HILLS



Model CS-140

GYRO TORQUER SUPPLY

- Precision Current Source
- DC and/or AC
- Pulse Output Possible

For testing and measurement of gyro torquers, zener, reference diodes, magnetic components, other current sensitive devices.

- Current Range is 0.1 μ A to 150 ma
- Regulation 0.002%
- Resolution 1 part per million

In use by leading companies for gyro torquer supply, component reliability testing, calibration, reference zener testing.

Literature describing this and other constant current sources from 0.1 μ A to 30 amp. may be obtained from



NORTH HILLS
ELECTRONICS, INCORPORATED
GLEN COVE, L.I., N. Y. ORiole 1-5700

CIRCLE 47 ON READER-SERVICE CARD

May-June, 1961

Stack-Mounting Resistors

Military power ratings in accordance with the provisions of MIL-R-26 are listed in the table below for the VZT series of power resistors. These wire-wound units on ceramic cores fitting over a metal frame are designed for space saving in either independent or in-

SPECIFICATIONS

CLAROSTAT		EIA		MIL-R-26			DIMENSIONS		
TYPE	Power Rating	STYLE	Power Rating	STYLE	Power Rating		A	B	C
					"G"	"V"			
V5ZT	30W	RRW20	15W	RW20	15W	21W	1 1/4	2	2 1/2
V8ZT	40W	RRW21	22W	RW21	22W	31W	2	2 1/4	3 1/4
V14ZT	55W	RRW22	37W	RW22	37W	53W	3 1/2	4 1/4	4 3/4
V19ZT	65W	RRW23	47W	RW23	47W	68W	4 1/4	5 1/4	6
V24ZT	75W	RRW24	63W	RW24	63W	91W	6	6 1/4	7 1/4

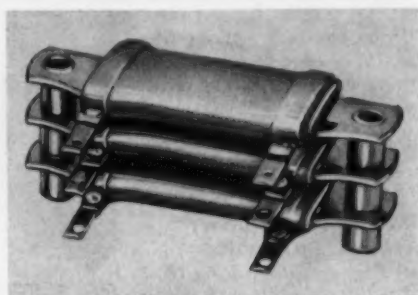


FIG. 1. VZT Series Stack mounting wirewound fixed resistors are coated with vitreous enamel finish.

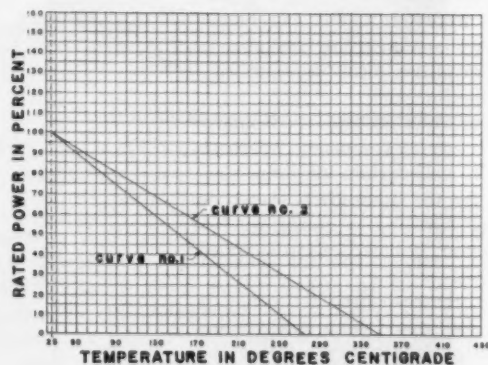


FIG. 2. DERATING CURVE No. 2 is applicable to enamel-coated VZT resistors.

terconnected resistance ranges. Tolerances are available in accordance with MIL-R-26, latest revision, and for either characteristic "G" or "V". Derating curve No. 2 in the graph in Fig. 2. applies. Mounting may be machine screws or metal rods. (From new 12-page catalog 11-60 Section 2, EEM 4700 "Fixed Wirewound Power Resistors", Clarostat Mfg. Co., Inc., Dover, N. H.)

FOR MORE INFORMATION CIRCLE 139 ON READER-SERVICE CARD

Research Responsibility Results

Hundreds of thousands of Aerotec disconnects, valves, flow indicators, pressure switches, and float switches have been produced for America's weaponry.



FROM SATELLITES TO SUBMARINES...

Aerotec components have proven their reliability under all service demands. This reliability results from a background of 16 years' experience in the design, development, and production of equipment to exacting specifications.

Use Aerotec's capabilities for the answer to your specific requirements.

Send details of your problem for our recommendations. Write us now. Our representatives are conveniently located for prompt liaison and service



AEROTEC INDUSTRIES, INC.

® Aircraft Equipment Division, Dept. M5, Greenwich, Conn.
PRECISION EQUIPMENT FOR AIRCRAFT, MISSILES AND NUCLEAR APPLICATIONS
West Coast Office: Culver City, California
Canadian Affiliate: T. C. CHOWN LIMITED, Montreal & Toronto
Other Aerotec divisions: Aerotherm Division, a pioneer in energy absorption, manufactures passenger and crew seating, lounges and accessories; Industrial Division, engineers, produces and installs dust collecting systems, gas scrubbers, fans, stacks and allied equipment.

CIRCLE 48 ON READER-SERVICE CARD

Electronic Transient Suppressors

Electronic circuitry, particularly those utilizing transistor and other solid state components, can be temporarily or permanently damaged by line transients and from transients induced by the switching of inductive loads. In addition, transients will often trigger switching circuits or cause other interference if they are not properly controlled.

Such transients may vary from only a few volts to several thousand volts, and can vary in duration from microseconds to many milliseconds. The TR Series transient Suppressors, properly applied, offer absolute protection against these undesired effects.

TR Series Suppressors are of three different types, each designed for a specific function:

The TRP dc, polarized, will suppress transients as shown in Fig. 1. However this unit may increase release times of relays in the circuit by several hundred percent.

The TR dc, non-polarized type, has the advantage that it will increase relay release times less than 50%, also it may be used in the circuit without regard for polarity.

The type TRA, ac, will suppress transients in ac circuits as shown in Fig. 2. One application of the TRA is in diode bridge protection for ac relay and other sealed circuits with internal diode rectification. In such cases, transients can damage the diode so that the unit becomes inoperative unless protection is provided.

Styles of Relcoil TR Series Transient Suppressors

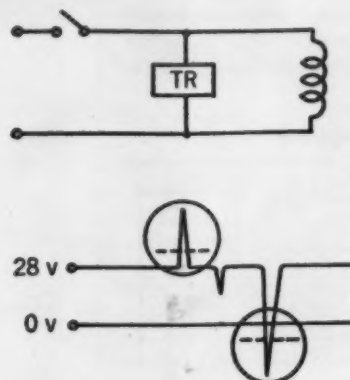


FIG. 1. DC TRANSIENT suppression. Type TRP (Polarized) and Type TR (non-polarized) action is much the same except that Type TR can be used without regard to polarity and has small effect on release time of any dc relay placed across the coil.

are shown in Fig. 3, left to right as follows; A, $\frac{1}{4}$ watt; B, $\frac{3}{4}$ watt; C, $1\frac{1}{2}$ watt; D, $1\frac{1}{2}$ watt (Mounting stud insulated from internal circuit); E, 10 watt; and F, 10 watt. (From 4-page brochure, "TR Series" Relcoil Products Corporation, Spring St. & Route 75, Windsor Locks, Conn.)

FOR MORE INFORMATION CIRCLE 140 ON READER-SERVICE CARD

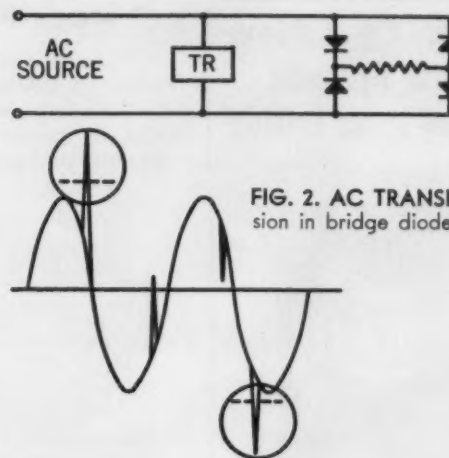


FIG. 2. AC TRANSIENT suppression in bridge diode circuit.

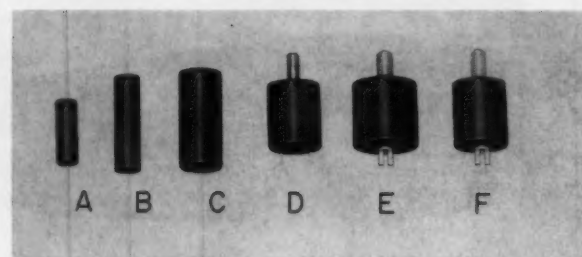


FIG. 3. STYLES and sizes of TR Series Relcoil Units are identified by letter in text of article.

Dual Polarized Antennas

Dual Polarized antennas are desirable in many locations where performance of the single unit can approach the performance of two separate linear antennas. In the 1700-2700 mc range, TACO simplifies the selection of transmit/receive polarization by locating the antenna inputs at the reflector edge, making an interchange of feed to respective inputs a simple matter. Both inputs are standard $\frac{7}{8}$ " EIA flange type, capable of pressurization (Fig. 1).

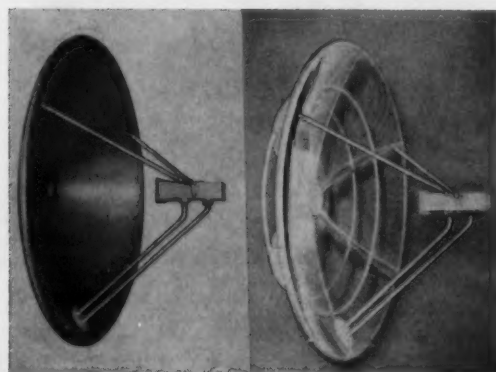


FIG. 1. DUAL POLARIZATION is simplified by locating antenna inputs at reflector edge, making interchange of feed to respective inputs easy.

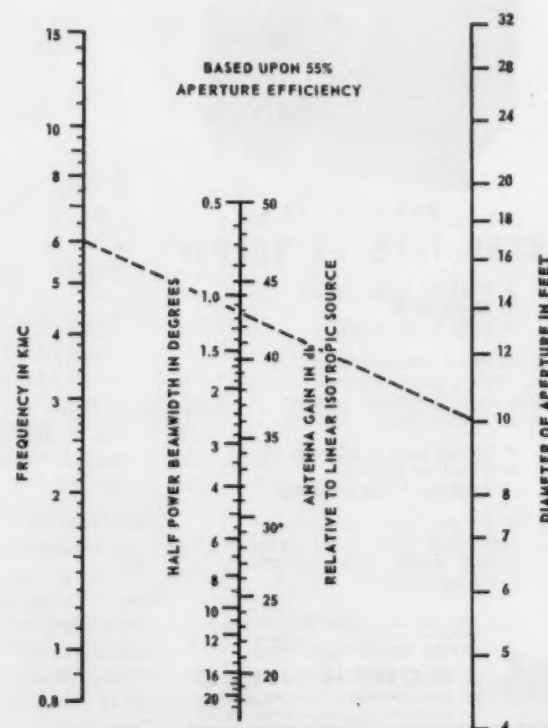
To meet the demands of systems requiring only a limited portion of the listed frequency range, special tuning of the feed for improved VSWR can be accomplished. Dual polarized antennas are available in four frequency ranges, in either mesh or spun construction and in four reflector sizes.

Selection of a specific antenna involves a consideration of the interacting factors of frequency, aperture, gain and beamwidth. The calculations of these relationships are simplified by the nomogram shown in Fig. 2. This nomogram, covering a range of frequencies, from 0.8 to 15 kmc, is based on an assumed aperture efficiency of 55%.

To use the nomogram, the operating frequency is located on the left scale and joined by a straight line to the point on the righthand scale representing the diameter of the antenna aperture in feet. The intersection of this line with the center scales permits the half power beamwidth in degrees to be read directly from the left hand center scale. Antenna gain in db is also read from this point of intersection but from the righthand center scale. (From 14-page catalog No. 100, "TACO Microwave Antennas," Technical Appliance Corporation, Sherburne, N. Y.)

FOR MORE INFORMATION CIRCLE 141 ON READER-SERVICE CARD

FIG. 2. FREQUENCY and Aperture vs. Gain and Beamwidth relationships based on an aperture efficiency of 55%. In the example shown, a 10' aperture antenna at 6 kmc will have a gain of 43.0 db and a half-power beamwidth of 1.14° .



MILITARY SYSTEMS DESIGN

CLUTCHES
SPEED REDUCERS



STERLING Components
a division of
STERLING PRECISION CORPORATION

DIFFERENTIALS

The largest single source of standard Precision Electro-Mechanical Components.

SPEED REDUCERS
CLUTCHES
DIFFERENTIALS
GEARS, PREC. I, II, & III
TOOL COMPONENTS
DEVELOPMENT COMPONENTS

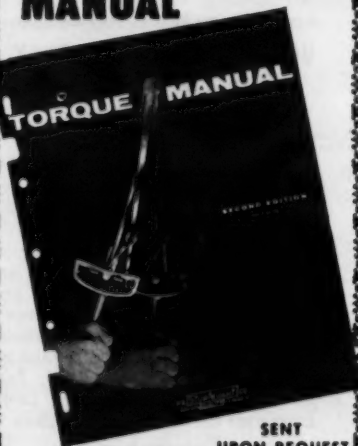
SHAFTING
GEAR HEADS
BRAKES

Write for our 512 page
NEW COMPLETE CATALOG.

5 Sintsink Drive East, Port Washington
New York Tel.: PO 7-8200

CIRCLE 49 ON READER-SERVICE CARD

TORQUE WRENCH MANUAL



SENT
UPON REQUEST

Formulas
Applications
Engineering Data
Screw Torque Data
Adapter Problems
General Principles

P.A. **STURTEVANT CO.**
ADDISON **QUALITY** ILLINOIS

CIRCLE 50 ON READER-SERVICE CARD

May-June, 1961

Pulse Connectors for Coaxial Cables

The new Pulse series of Kings Electronics RF connectors are available in ceramic-insert type, rated to 15,000 volts peak at sea level; and the rubber-insert type rated to 5,000 volts at an altitude of 50,000 ft. UF-34/U Plug, the UG-37A/U receptacle and the UG-264/U Receptacle are illustrated (Fig. 1).

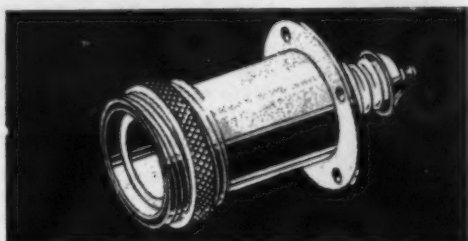


FIG. 1. PULSE SERIES RF connectors with ceramic inserts are rated to 15,000 v peak at sea level.

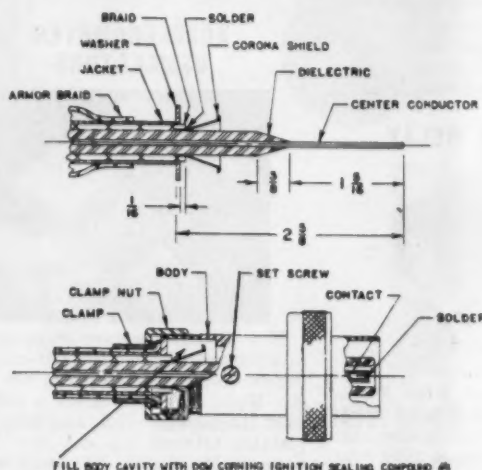
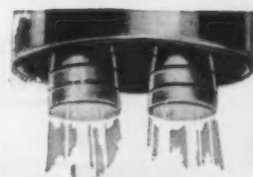


FIG. 2. CABLE PREPARATION for insertion in Pulse Series Connectors is simple.

Preparation of cable for use with the Ceramic-insert type connector is shown in Fig. 2. The upper view shows trimming of the armor, the jacket and the inner braid and insertion of the ceramic corona shield. The lower view shows the cavity formed around the corona shield which is filled with Dow Corning Ignition Sealing Compound #4 to ensure arc-over protection against high-voltage peaks. (From new 120-page catalog on manufacturer's series: BN, BNC, C, HN, LC-LT, LN, N, Pulse, Miniature and sub-miniature, Twin Connectors, UHF, Miscellaneous Connectors and Adapters, Adapters to Rigid Line, Waveguide Adapters, Captivated, Foamflex, Spiralfil, Styroflex, Power TNC, K-Grip, Polarized Fuel Gauge, Coaxial Cable Termination, Radiation Resistant, 125-ohm High Impedance, and Hermaphrodite Types, Kings RF Connectors, Kings Electronics Company, Inc., 40 Marbledale Rd., Tuckahoe, N. Y.)

FOR MORE INFORMATION CIRCLE 142 ON READER-SERVICE CARD



ALTITUDE



EGT (AUTOTEMP®)



TURBINE PRESSURE



FUEL FLOW & QUANTITY



% R.P.M. (AUTOTAK®)

HOWELL

INSTRUMENTS



COMPREHENSIVE INSTRUMENTATION

HOWELL INSTRUMENTS are calibrated for use with all transducers for the measurement of the phenomena encountered in all phases of aircraft and missile development, test and operation. Each instrument is completely self-contained (miniaturized, silicon transistorized, servo-driven, hermetically sealed) with Zener reference, power supply, amplifier, servo motor, cold junction compensation as needed and the 144-inch slide-wire and punched tape to linearize e.m.f. for exact, counter-type digital read-out. Needle pointers are provided for quick reference. Accuracies are within 0.1%. Available in 3"-dia. MS33639 and 2"-dia. MS33598.

Styler Series BH183 & 185—*The Instrument with the Tape-Slidewire*—these instruments are produced by the makers of the JETCAL® Analyzer, the only jet engine tester used throughout the world!

Full information is available for the asking.

Sales-Engineering Offices:

COMPTON, CAL., DAYTON, O., VALLEY STREAM, L.I., N.Y.,
WICHITA, KAN., TORONTO, ONT. (George Kalk Ltd.),
MITCHAM, SURREY, ENGLAND (Bryant Aerogroup Ltd.)



HOWELL INSTRUMENTS, INC.

FORMERLY B & H INSTRUMENT CO., INC.
3479 WEST VICKERY BOULEVARD • DORT WORTH 7, TEXAS

CIRCLE 51 ON READER-SERVICE CARD

OCLI

ASSISTANT TO THE INFRARED SYSTEMS DESIGNER

*Specialists in Design,
Development and Volume
Production of Vacuum
Deposited Coatings
for the Infrared...*

OCLI offers these services and products to the Infrared Physicist and Engineer:

RESEARCH—OCLI maintains a separate Research Department which has made significant contributions to the science of thin films. Among the products it has made possible are: The 8 Micron Long Wavelength Pass Filter, an 8-13 micron window which permits observation of black bodies radiating in the region beyond 8 microns, while rejecting energy of shorter wavelengths. Blue-Red Reflecting Solar Cell Cover Slips, designed to increase solar cell operating efficiency by decreasing the cell operating temperature in space. HEA (High Efficiency Anti-reflection Coating), for reduction of glass surface reflections to less than .5% over the visible spectrum.

COMPUTER FACILITIES—Though OCLI's IBM 1620 computer and exclusive programs are primarily a tool of the Research Department, they are also available to assist our engineers in determining the optimum infrared filter for a specific system.

QUALITY CONTROL—OCLI has the finest testing equipment available. Spectrophotometers, optical test instruments and humidity chambers are under the direct supervision of our Quality Control Engineer. All filters are thoroughly tested. Complete test data accompanies each shipment.

PRODUCTION—Our Production Department, equipped with more than 25 vacuum chambers, can produce Long and Short Wavelength Pass, and Wide and Narrow Band Pass Filters, covering the infrared from 1-25 microns. All filters can be held to rigid specifications, and will exhibit exceptional transmission, reflection, environmental, and physical durability characteristics.

For further information on OCLI vacuum deposited thin films for the infrared, contact:

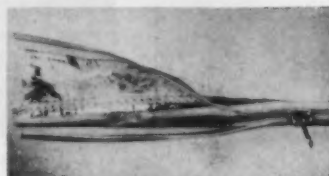
**OPTICAL COATING
OCLI
LABORATORY, INC.**
TELETYPE ZR 33

2789 GIFFEN AVENUE, SANTA ROSA, CALIFORNIA
OCLI / EXCELLENCE IN THIN FILMS

CIRCLE 52 ON READER-SERVICE CARD



CABLE ZIPPER SHIELD



New type SH shielded Zippertubing uses 1-mil aluminum foil laminated to vinyl impregnated glass cloth to solve transient RF interference problems. Jackets may be easily opened for inspection or maintenance of circuits or permanently sealed with ZT sealer.—*The Zippertubing Co., 13000 S. Broadway, Los Angeles 61, Calif.*

CIRCLE 143 ON READER-SERVICE CARD

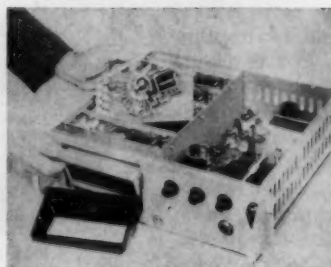
HI-SENSITIVITY RELAY



New Model TR-116-B High Sensitivity electronic transistorized relay operates on 120 v, 400 cps power, can be floated at plus or minus 1500 v to ground. Operates on 7 μ amp at 50 mv to move 4-pole double-throw contacts rated at 5 amp inductive.—*Med-Tronics Mfg. Co., Inc., 2019 Westchester Ave., New York 62, N. Y.*

CIRCLE 144 ON READER-SERVICE CARD

DIGITAL VOLTMETER



New Type 481A four-digit voltmeter with $\pm 0.01\%$ accuracy features plug-in stepping switches for quick trouble-shooting and easy maintenance.—*Non-Linear Systems, Inc., Del Mar, Calif.*

CIRCLE 145 ON READER-SERVICE CARD

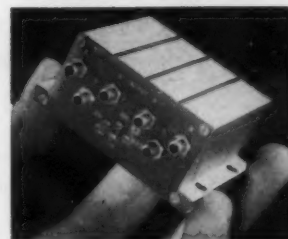
PRESSURE TRANSDUCER



New Series 200 Filp pressure transducer having a thickness of only 0.035" and an overall size of 1" x 1" can be suspended or applied directly to plane or curved surfaces in which pressure measurements are required. Sensitive area is 1 square cm, and responds only to forces normal to the area, in the pressure range of 15" Hg vacuum to 100 psi. Pressure changes electrical capacity of the transducer, which may be used with bridge or resonant circuits.—*Spitz Laboratories, Inc., Yorklyn, Del.*

CIRCLE 146 ON READER-SERVICE CARD

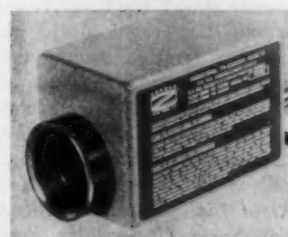
ACCELEROMETER OSCILLATORS



New Glennite square wave oscillators for use with Gulton self-calibrating oscillators are offered in two models. Model FO 1060 gives a 200 cps fixed frequency with amplitude adjustable between 0.1 and 10 v peak-to-peak. Model FO 1061 may be set manually to 20, 100 or 200 cps. Either unit drives six accelerometers simultaneously.—*Gulton Instrumentation Div., 212 Durham Ave., Metuchen, N. J.*

CIRCLE 147 ON READER-SERVICE CARD

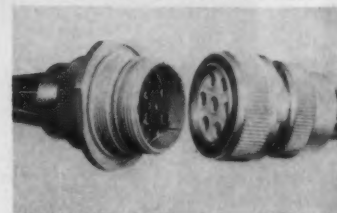
ITV ZOOM LENS



New Zoomar Mark-VI ITV lens uses new miniature dc motor to eliminate noise and RF interference. Sealed cover makes lens dust- and explosion-proof, meeting applicable MIL-specs.—*Zoomar, Inc., Glen Cove, L. I., N. Y., and Hollywood 28, Calif.*

CIRCLE 148 ON READER-SERVICE CARD

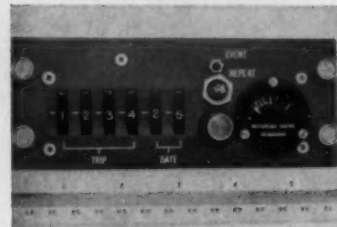
7-PIN COAX CONNECTOR



New high-strength connector comprises seven individual snap-in coaxial contacts that can be removed from the connector with an extraction tool. Contacts retain coaxial cable with a minimum of 15-lb force. Accommodates RG/58U, RG/187U, RG/188U and RG/195U cables.—*Viking Industries, Inc., 21343 Roscoe Blvd., Canoga Park, Calif.*

CIRCLE 149 ON READER-SERVICE CARD

SWITCHING DECK



Deck-stacking format of new Model SD101 series switch only $\frac{1}{4}$ " wide allows more compact designs, as in six-switch encoder shown. 1 to 10 switching sequences per switch, with each switch individually replaceable.—*Valor Instruments, Inc., 13214 Crenshaw, Gardena, Calif.*

CIRCLE 150 ON READER-SERVICE CARD

VOLTAGE SENSING RELAY



New adjustable voltage sensing relay senses ac or dc voltage levels and operates relay contacts when a predetermined voltage, adjustable over a broad range, is attained. Designed only to customer specs, write your requirements to company.—*Hi-G, Inc., Bradley Field, Windsor Locks, Conn.*

CIRCLE 151 ON READER-SERVICE CARD

PITOT-STATIC TUBE



Subsonic and supersonic flight pressures are both accurately compensated in a new pitot-static tube, REC Model 855. It also avoids large computed corrections formerly required in previous pitot-static tubes.—*Rosemount Engineering Co., 4900 West 78th St., Minneapolis 24, Minn.*

CIRCLE 152 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

Resistor Noise

One of the important sources of noise in electronic circuits is the current-carrying resistor. All resistors generate a fluctuation voltage, commonly called "Thermal Noise," in an amount equal to a theoretical value, determined by the resistance, the bandwidth and the absolute temperature.

Virtually all composition and deposited-film resistors, as well as defective wire-wound resistors, generate *additional noise*, often many times the theoretical value, when a voltage is applied across them. This noise, rather than tube or transistor noise, often can be the determining factor in establishing the noise figure of a circuit. The noise problem becomes especially acute in low-level audio and low-frequency circuits, since this excess noise exhibits a typical $1/f$ characteristic.

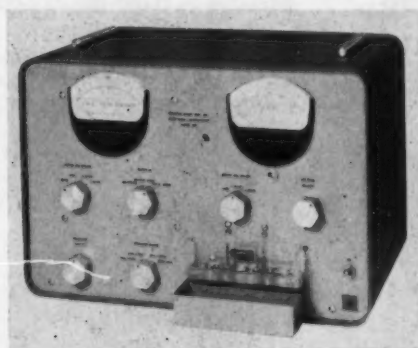


FIG. 1. RESISTOR NOISE is quickly measured by placing the resistor in the test jig of the Model 315 Resistor-Noise Test Set. For special applications a remote sensing cable is available.

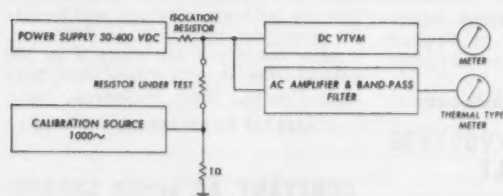
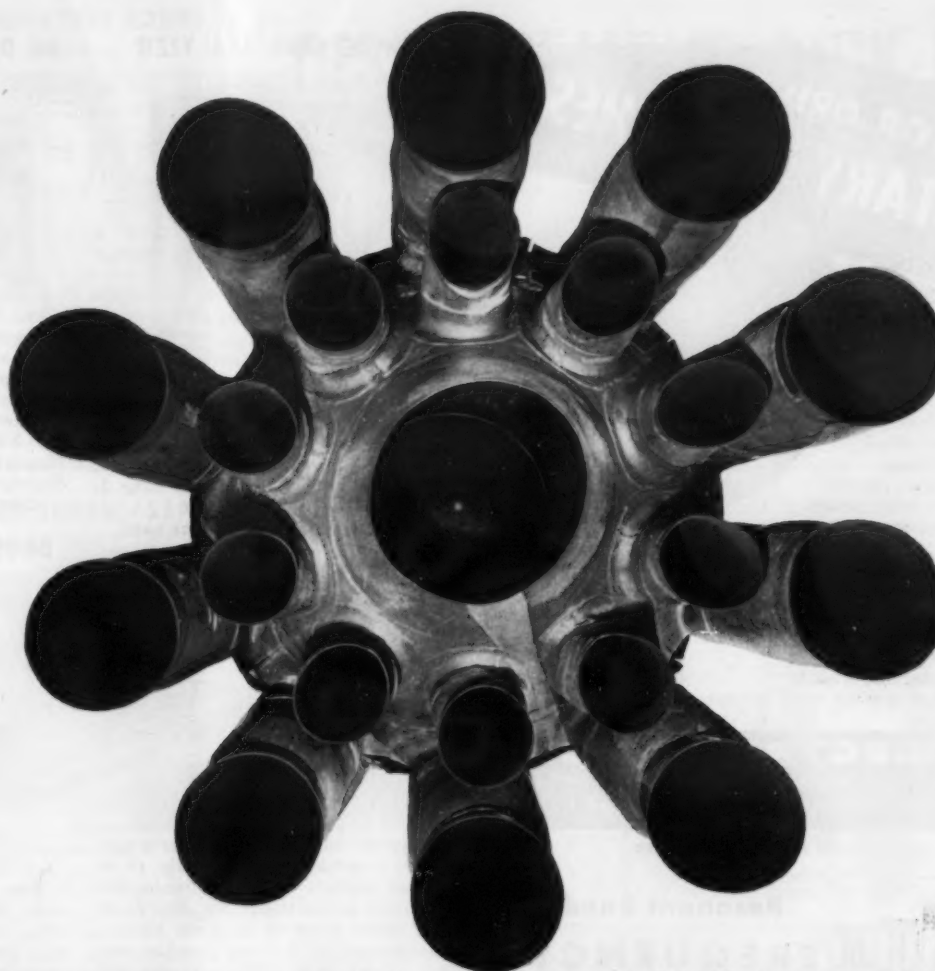


FIG. 2. SIMPLIFIED Block Diagram of Model 315.

The Model 315 Resistor-Noise Test Set (Fig. 1) tests resistors of all types from 100 ohms to 22 megohms, measuring noise voltages from $0.6 \mu\text{v}$ in a decade of frequency to $1000 \mu\text{v}$ in a decade. Bandwidth is 1000 cycles centered at 1 kc.

Where minimum noise and maximum reliability are of consequence, preselection of resistors with the Model 315 is of inestimable value. In production or quality control testing, where the absolute noise value is less important than assuring that no resistor of a batch exceeds a specific noise level, an output is available at the rear of the 315 to drive a go-no-go indicator. (From 4-page technical brochure, "Model 315 Resistor Noise Test Set," Quan-Tech Laboratories, Inc., Boonton, N. J.)

CIRCLE 153 ON READER-SERVICE CARD



what!—counters on jets? Lots of them. Kollsman puts them there. And Veeder-Root supplies Kollsman, providing jet pilots with direct read-out—immediate indication of the vital data necessary for controlling aircraft travelling at jet speeds. Can Veeder-Root help your performance? Better find out. Write to Instrument Section, Veeder-Root Incorporated, Hartford 2, Connecticut. count on...Veeder-Root



Modern thrustmeter—one of many special instruments which uses Veeder-Root counting ingenuity—shows pilots the power conditions necessary for safe take-off.

CIRCLE 53 ON READER-SERVICE CARD

MOTOR-DRIVEN ROTARY SWITCHES

Special designs to meet your performance specifications for high-speed precise multi-circuit switching in complex electric and electronic systems and instrumentation.

Built to meet severe environmental conditions and MIL specifications.

Capacities and sizes from subminiature dry-circuit selectors to heavy-duty power-handling commutators.

Write for check-list to use in specifying motor-driven rotary switches.



ELECTRO SWITCH
SLIP-RING DIVISION, CORP.
OSTERVILLE, MASSACHUSETTS

CIRCLE 54 ON READER-SERVICE CARD

FRAHM Resonant Reed FREQUENCY METERS

15 to 1500 cps
(Special up to 1700 cps)

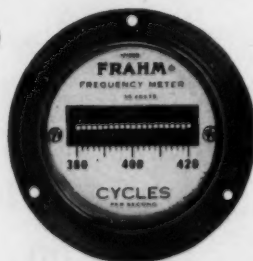
2 to 62 reeds

Molded Plastic
or Metal Cases

Sealed if required

2½" to 8½"

Panel Mounting
or Portable



Voltages 100 to 150 v.—D.C. resistance 100 ohms per volt—
Instruments meet MIL Specification

Cases meet ASA standard diameter dimensions

3½" meters available in round plastic, round metal (sealed or
unsealed), or round plastic with square bezel

Portable instruments available with 3½" meters

Write for BULLETIN 32-MS

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments
1316 ARCH STREET, PHILADELPHIA 7, PA.

CIRCLE 55 ON READER-SERVICE CARD

WIDE BAND ANALYZER



Model WSA Spectrum Analyzer covers the frequency range from 10 mc to 40 kmc in 20 bands selectable by illuminated push-button switches.—Polarad Electronics Corporation, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 154 ON READER-SERVICE CARD

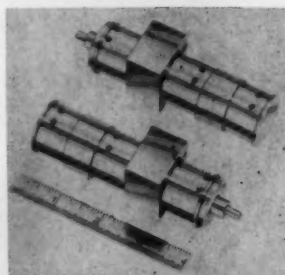
SOLID STATE DEMODULATOR



New Model 6004 unit converts suppressed carrier input signals to dc output signals with amplitude and polarity proportional to amplitude and phase sense of ac input signals. Input signal of 5 v rms provides output of ± 5 v dc with reference and input signal frequency variations from 200 to 50,000 cps.—Natel Engineering Co., Inc., 15922 Strathern St., Van Nuys, Calif.

CIRCLE 155 ON READER-SERVICE CARD

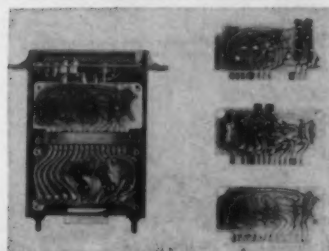
CLUTCH-BRAKE



New miniature Model 201-100-1 consists of two differentially coupled clutches with an integral, anti-backlash brake. The 0.375" dia input shaft may be driven in one direction continuously while the 0.187" dia output shaft remains stationary or is driven in either direction depending on which of three sets of terminals are energized.—Marketing Computers, Inc., 50 St. Benedict, Florissant, Mo.

CIRCLE 156 ON READER-SERVICE CARD

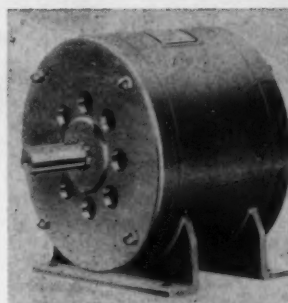
DC DIFFERENTIAL AMPLIFIER



Stable gain characteristics over a wide range of function and ranges made possible by interchangeable signal-conditioning boards are featured by new DC differential amplifier with 0 to 5 v output to telemeter system.—Magnetic Research Corp., 3160 W. El Segundo Blvd., Hawthorne, Calif.

CIRCLE 157 ON READER-SERVICE CARD

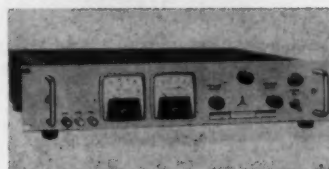
BRUSHLESS AC GENERATOR



New NOBRUSH lowspeed 1200 rpm 60 cps generator 6½" long, 10½" wide by 9" high and weighing only 50 lbs now has .5 KVA 3-phase capacity, double former capacity while retaining high overload capacity and virtual immunity to damage by short circuit.—Georater Corporation, Manassas, Va.

CIRCLE 158 ON READER-SERVICE CARD

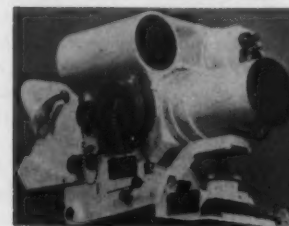
CONSTANT CURRENT/VOLTAGE POWER SUPPLY



New Mercury Series regulated transistorized power supply makes instantly available a choice of constant voltage output or constant current output, selected by a mode switch with knob located on the rear panel. Both modes have dynamic regulation to better than 0.05% and with response time better than 50 μ sec. Ripple is less than 1 mv rms. The units are available in five voltage-current combinations, from 0-15 v, 0-10 amps; to 0-160 v, 0-1 amp.—Trygon Electronics, Inc., 111 Pleasant Ave., Roosevelt, L. I., N. Y.

CIRCLE 159 ON READER-SERVICE CARD

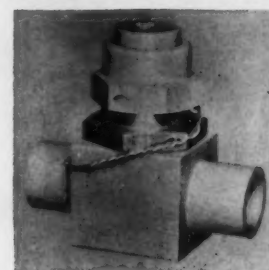
TRACKING TELESCOPE



Sighting Telescope Model WS-10, with mounting compound and Acquisition Aid, is for use by armed forces and range test groups in tracking objects in flight, boresighting, aligning and measuring. Acquisition Aid provides superposition of radar scope display.—Wollensak Optical Co., Rochester, N. Y.

CIRCLE 160 ON READER-SERVICE CARD

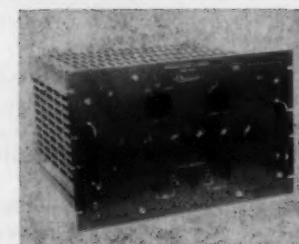
TELEMETER VALVES



New blanking valve PI-456 allows a transducer to function during a circuit's low pressure operation while blanking it off at pressures higher than the transducer can withstand. For use with air, nitrogen and helium in operating pressures to 6000 psi, closing pressures are from 8 to 300 psi.—James, Pond & Clark, Inc., 2181 East Foothill Blvd., Pasadena, Calif.

CIRCLE 161 ON READER-SERVICE CARD

CONSTANT AC or DC SOURCE

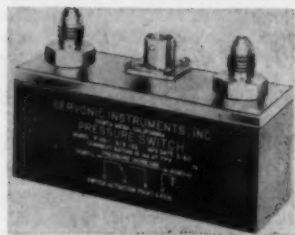


New programmable constant current source designed for gyros, semiconductors and magnetic components furnishes currents from 0.1 μ a to 150 ma for load voltages from 0 to ± 100 v. If driven from external modulating signal can supply ac currents from dc to 6 kc, or to provide pulse outputs.—North Hills Electronics, Inc., Glen Cove, L. I., N. Y.

CIRCLE 162 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

Differential Pressure Switch Monitors MERCURY Abort System



DIFFERENTIAL PRESSURE
SPDT switch is monitor element in MERCURY "Man-Into Space" ATLAS booster. Low differential pressure between fuel and oxidizer tanks activates "abort" circuit to fire space capsule away from booster in trouble.



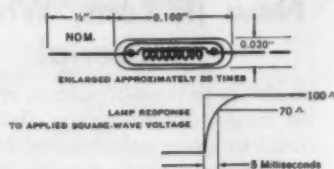
An extremely sensitive differential pressure switch has been selected to monitor the pressure difference between the fuel and oxidizer compartments in the ATLAS booster that will lift the MERCURY capsule into space. This switch determines whether the "abort" system will fire if the booster malfunctions.

The switch detects if the pressure differential between the fuel and the oxidizer tanks becomes critically low. A difference in pressure is necessary to support the thin stainless steel bulkhead between the two compartments. If it collapses, mixing of the fuel and oxidizer results in immediate and violent explosion. Normal operation is at 30 psid. Reduction of this differential to 2½ psid requires instant actuation of the abort system, even under extreme environmental conditions, to detach the capsule from the ATLAS booster and to trigger the escape rockets poised on a pylon at the nose of the capsule. Timers and sensors which will open the parachute and prepare landing equipment in the capsule then begin to operate.

The switch, designed by Servonic Instruments, Inc., 1644 Whittier Ave., Costa Mesa, Calif., and designated their Type P-20, is electrically a make-before-break SPDT pressure actuated unit. The two pressures are isolated from each other by the dual aneroid pressure elements in the switch—each rated at 75 psi-burst—so that both aneroids must fail before any mixing could occur.

FOR MORE INFORMATION CIRCLE 408 ON READER-SERVICE CARD

MICROMINIATURE LAMPS



Two new PINLITE incandescent lamps are Type 13-7, "Lowest Power" lamp using only 6.74 ma at 1.35 v and pulsing to half brightness in 4 milliseconds; and Type 30-30 "High Output" lamp providing 250 millilumens on 30 ma at 3 v. Dimensions are 1/64" dia by 1/16" long for Type 13-7; 0.030" dia by 0.100" for type 30-30.—Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.

CIRCLE 163 ON READER-SERVICE CARD

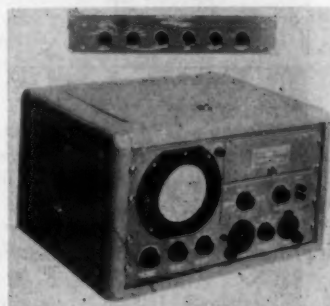
COUNTER CHRONOGRAPH



New portable electronic counter chronograph measures bullet velocity, has 250-5000 fps range, 0.05% laboratory accuracy. Uses 115-v current or 12-v car battery. Elapsed milliseconds are read after bullet is shot through start and stop screen connected to chronograph.—Avtron Manufacturing, Inc., 10409 Meech Ave., Cleveland 5, Ohio.

CIRCLE 164 ON READER-SERVICE CARD

SPECTRUM ANALYZER AUXILIARY



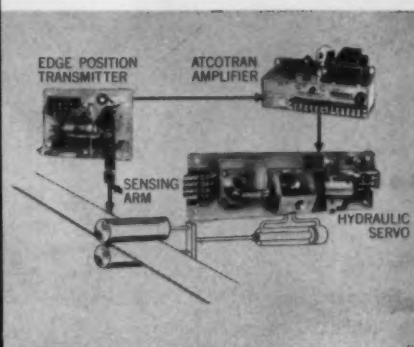
New Type "C-2" auxiliary unit with LP-1a Sonic Analyzer permits location of discrete and random signals faster and over a broader range than before possible. 2 cps resolution is provided from 5 cps through 22.5 kc.—Panoramic Radio Products, Inc., 520 So. Fulton Ave., Mount Vernon, N. Y.

CIRCLE 165 ON READER-SERVICE CARD

DISPLACEMENT PICK-UPS FOR MACHINE AUTOMATION

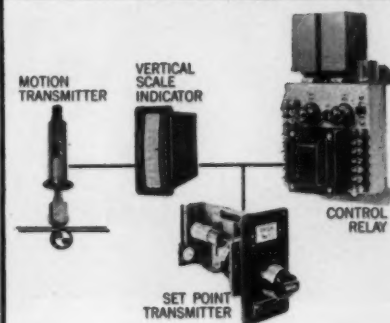
EDGE CONTROL

Atcotran Edge Guide Control maintains constant, precise edge positioning (within 0.001") for accurate register of moving web. Range is 2¼" with only ¼ oz. pressure on edge. Stable null balance circuit. For paper, metals, textiles, plastics, etc.



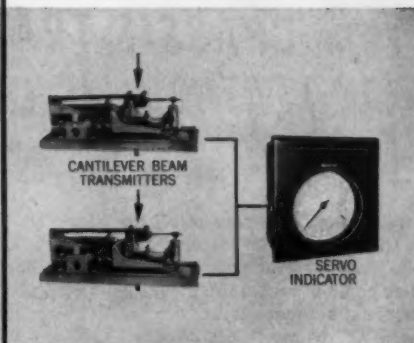
THICKNESS MEASUREMENT

ATC measuring devices for reliable automation control systems. Indicates and controls thickness to adjustable pre-set tolerance. Ideal for wallboard, sheet metal, plywood, plate glass, etc.



WEIGHT SUMMATION

ATC Cantilever Load Cells change force (or weight) to electrical signal, recorded as weight on servo indicator. Multiple load cells may be algebraically coupled for indication-control of force, thrust, torque, etc.



ADVANCED DIFFERENTIAL TRANSFORMER PRINCIPLE permits simple and rapid automation of machine functions using standard off-the-shelf control components, indicators, recorders, and process controllers. Discuss your applications and requirements with your ATC representative.



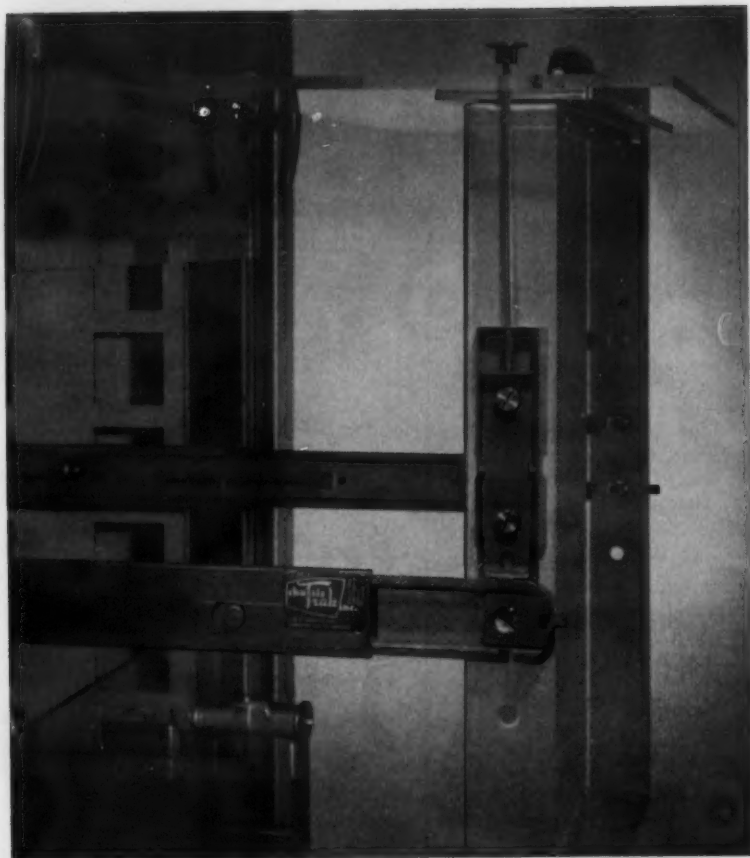
Send for literature on Atcotran Differential Transformer Experimental Kit—today!



**AUTOMATIC TIMING
& CONTROLS, INC.**
KING OF PRUSSIA, PENNSYLVANIA
A Subsidiary of American Manufacturing Company, Inc.

ATC, Div. of Interprovincial Safety Industries, Ltd., 5485 Notre Dame St., West, Montreal 30, Quebec

CIRCLE 56 ON READER-SERVICE CARD



From CHASSIS-TRAK NEW FEATHER-LIGHT DETENT SLIDE!

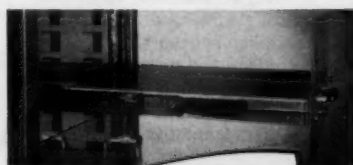
Model C-300 Detent locks in three service positions —
90° up, horizontal, 90° down

Chassis-Trak continues to set the pace in slide design with the new Model C-300 Detent. Never before has a tilt-lock slide come in such a small package, yet despite its space-saving size — 1 3/4" high, 3/4" wide — the Model C-300 Detent will support chassis loads up to 50 lbs. Not the least of the new slide's attractive features is its low price — lowest of any detent slide on the market.

Made of hard, cold-rolled steel, each slide is cadmium plated and then coated with Poxylube 75, a bonded film formulation of molybdenum disulfide, which provides permanent dry lubrication. Solid bearings on all surfaces afford high resistance to shock and vibration.

Model C-300 Detent Slides are available in seven lengths — 12 to 24 in. — and are designed for mounting electronic equipment in any standard rack or cabinet. Like all Chassis-Trak Slides, they are easy to install and smooth and trouble-free in operation.

Model C-300 Detent slide shown
locked in horizontal position.



**chassis
trak
inc.**

For further information contact:

525 South Webster, Indianapolis 19, Indiana

CIRCLE 57 ON READER-SERVICE CARD

New IR Lens, Window Material

Accessibility to the 8-13 micron atmospheric window for lenses, domes, prisms, flats and cell-windows used in space vehicles and laboratory infrared applications is made possible by a new infrared-transmitting material, Irtran-2. Described by officials of the Apparatus and Optical Division, Eastman Kodak Co., Rochester, N. Y., as an optical material about as strong as glass, with a hardness of 345 Knoop, its high refractive index permits a high lens power with a relatively shallow curve (Fig. 1).

Irtran-2 material differs from previously announced Irtran-1 by transmitting over 70% of impinging energy from 2.5 to about 10 microns through 2mm thickness. There is virtually no scattering of absorption loss due to thickness of material in the 3-9 micron region, all loss coming from Fresnel reflection. This may be reduced through the use of anti-reflection coatings to further en-

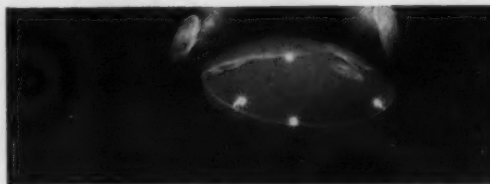


FIG. 1. MOLDED f/1.0 aspherical lens in Kodak Irtran-2 material. High refractive index gives high lens power with relatively shallow curvature.

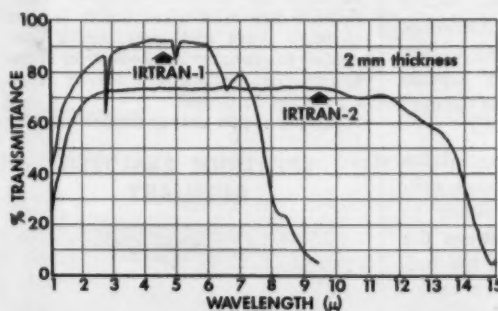


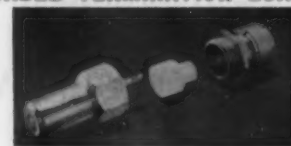
FIG. 2. TRANSMITTANCE of Irtran-1 compared to that of Irtran-2. The two materials complement each other in space vehicle and military applications.

hance the transmittance characteristics of Irtran-2 (Fig. 2).

Unlike Irtran-2, Irtran-1 has a very low refractive index, and consequently higher transmittance (more than 90% from 3 to 6 microns) with no need for anti-reflection coatings. In addition, Irtran-1 transmits both micro-wave and infrared energy, finding application in dual mode systems (IR and radar). Its microwave characteristics include a dielectric constant of about 5 and a loss tangent of about 10^{-4} .

FOR MORE INFORMATION CIRCLE 144 ON READER-SERVICE CARD

CABLE TERMINATION LOADS



New dummy loads for 50- or 75-ohm coaxial cables are now available in ConheX models for mating with snap-on or screw-on type connectors. —Sealectro Corporation, 610 Fayette Ave., Mamaroneck, N. Y.

CIRCLE 167 ON READER-SERVICE CARD

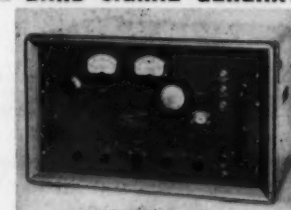
SEMICONDUCTOR MOUNT KITS



New Tri-Plate® semiconductor mounts for pill tunnel diode and pill varactors enable rapid breadboard assembly of harmonic generators, parametric amplifiers, oscillators, pulse amplifiers and down converters. Tri-Plate Kit information on request. —Microwave Prod. Dept., Sanders Associates, Inc., Neuscha, N. H.

CIRCLE 168 ON READER-SERVICE CARD

K_A BAND SIGNAL GENERATOR



New Model 100 stabilized signal generator covering the 32.0 to 37.5 kmc range provides average power output of 15 mw with short term stability within 0.01 ppm, long term stability to 1 ppm. —Strands Labs, Inc., 294 Centre St., Newton 58, Mass.

CIRCLE 169 ON READER-SERVICE CARD

VARIABLE COAX ATTENUATOR



New Model RDA-1196 coaxial attenuator having continuously variable 0-125 db attenuation above a maximum 1 db insertion loss is believed to be unique. Knob can be removed for servo-drive applications. —Radar Design Corp., Pickard Drive, Syracuse 11, N. Y.

CIRCLE 170 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

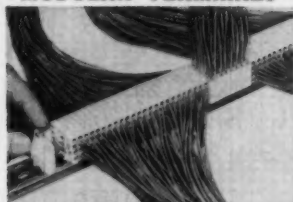
SIZE 23 SYNCHROS



Line of Size 23, 60 cps Thru-Bore Synchros in transmitter, transformer, differential transmitter and receiver-transmitter types for servo applications are described in new 2-page data sheet.—*Vernitron Corp.*, 125 Old Country Road, Carle Place, L. I., N. Y.

CIRCLE 171 ON READER-SERVICE CARD

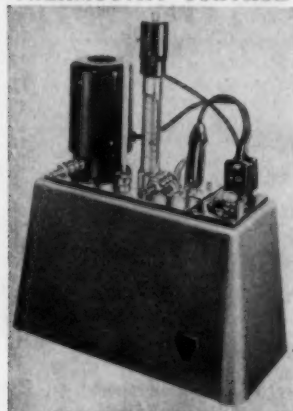
MODULAR TERMINALS



New miniature modular terminal block with a variety of bussing arrangements possible is called MINI-LOK. Provides 100 connections in only 2½" with nylon modules interlocked on PVC plastic track cut to any length.—*Burndy Corporation*, Norwalk, Conn.

CIRCLE 172 ON READER-SERVICE CARD

CIRCULATING BATH THERMOSTAT CONTROL



New Haake Type F Ultra Thermostat designed for closed-circuit operation with water-jacketed instruments is also suitable for installation inside larger pieces of equipment requiring built-in temperature regulation and for ambulatory use with clinical appliances such as blood pH meters, etc. Modification Type FSe has 1 gal./min. capacity suction pump for control of open baths.—*Brinkmann Instruments, Inc.*, 115 Cutter Mill Rd., Great Neck, L. I., N. Y.

CIRCLE 173 ON READER-SERVICE CARD

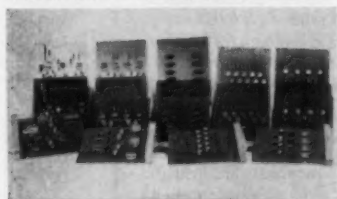
HOT GAS CHECK VALVES



New piston check valve types 4C127-1 and 4C136 for handling hot ballistic gases in ejection seat and canopy systems withstand erosive action of high velocity, high temperature gases; data available on 2-page bulletin.—*Allen Aircraft Products, Inc.*, P. O. Box 271, Ravenna, Ohio.

CIRCLE 174 ON READER-SERVICE CARD

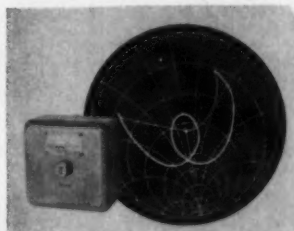
DIGITAL BUILDING BLOCKS



New transistorized plug-in modules, available in 13 subcircuits designed by the Nat. Bureau of Standards for data processing applications, are described in series of bulletins.—*Digitrols, Inc.*, Cockeysville, Md.

CIRCLE 175 ON READER-SERVICE CARD

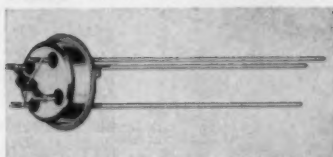
SMITH CHART PLOTTER



Rapid impedance and admittance measurements of diverse RF components and networks to VSWR uncertainty as low as 1.01 are quickly read or photographed with new plotter.—*Dielectric Products Engineering Co.*, Raymond, Me.

CIRCLE 176 ON READER-SERVICE CARD

FIELD EFFECT TRANSISTOR



New silicon field-effect transistor, utilizing majority carriers instead of minority carriers has high input and output impedances, high stability and low noise characteristics combined with extreme switching speeds.—*Mr. A. S. Coburn, Crystallonics, Inc.*, 249 Fifth St., Cambridge 42, Mass.

CIRCLE 177 ON READER-SERVICE CARD

CIRCLE 58 ON READER-SERVICE CARD →

...for **MINIATURIZATION**



NEW!
miniature
BALL
BUSHINGS
for
LINEAR
MOTIONS



LOW FRICTION and WEAR
LASTING PRECISION ALIGNMENT
ELIMINATE BINDING and CHATTER
ZERO SHAKE or PLAY
LONG LIFE—LOW MAINTENANCE
SOLVES SLIDING LUBRICATION PROBLEMS

Used by progressive engineers in the latest guidance, fire control and navigation systems, computers, inertial devices, instruments.

Various types of BALL BUSHINGS are made for shaft sizes from ⅛" to 4"... with small sizes available in Stainless Steel. Write for literature and name of our representative in your city.

THOMSON INDUSTRIES, Inc.

Dept. D, MANHASSET, NEW YORK

LOOKING FOR BUBBLES ANTENNA SEAL TEST

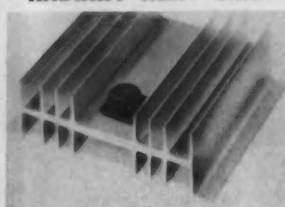
In the seal test to qualify for the supersonic B-58, Transco L-band antennas are placed in a chamber evacuated to 28.88 inches of mercury (75,000 ft.). Ice cubes keep the water between 33° and 40° so that it will not boil while the test engineer checks for air bubbles. Transco engineers developed special epoxy sealing techniques to pass this severe test. If you have a design or development requirement for antennas or antenna sub-systems, call a Transco application engineer or representative... located throughout the United States and Canada... or write Transco Products Inc., 12210 Nebraska Ave., Los Angeles 25, California.



COAXIAL SWITCHES • WAVEGUIDE SWITCHES • ANTENNAS • MICROWAVE COMPONENTS • VALVES • ACTUATORS

CIRCLE 59 ON READER-SERVICE CARD

RADIANT HEAT SINK



New series 4AL heat radiators dissipate heat from power transistors at 50, 100, 200 and higher wattage rates. Radiators also act as a chassis in which diodes and transistors can be mounted on one side, components on the other. Width is 4 1/2", length available in 1/2" increments to 12 ft. Material is aluminum, finish black anodize per MIL-A-8625.—The Birther Corp., Industrial Div., 745 So. Monterey Rd., Monterey Park, Calif.

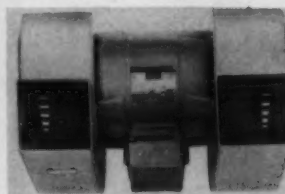
CIRCLE 178 ON READER-SERVICE CARD

PARABOLIC ANTENNA CALCULATOR

New parabolic antenna calculator quickly provides wavelength in inches, beam width, db gain at given efficiency, free space attenuation, subtended angle at given F/D, return loss and mismatch loss vs VSWR, and force (lbs transferred to mounting at velocities from 5 to 200 mph.—Technical Appliance Corporation, Sherburne, N. Y.

CIRCLE 179 ON READER-SERVICE CARD

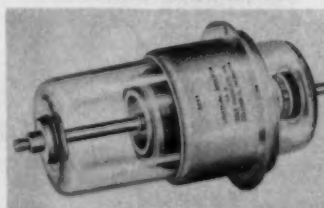
DUPLEX BLOWER



New Model MSA-11100 dual centrifugal blower operating on 220/440 v 60 cps 3-phase power delivers 1700 cfm at a static pressure of 1.4" H₂O.—Specialty Blower Div., The Torrington Company, Torrington, Conn.

CIRCLE 180 ON READER-SERVICE CARD

LIGHTNING ARRESTOR



New Type LA-4 normally used as transmitter lightning arrester features magnetic type spark gap exceeding MIL-A-9094C and RF spark gap voltage of 11,250 v peak at 2 mc and 50,000 ft altitude.—Dale Electronics, Inc., Columbus, Nebr.

CIRCLE 181 ON READER-SERVICE CARD

Uncooled IR Detector

Although not superior to all other IR detectors in any one property (except possibly speed of response) the uncooled photoconductive Indium Antimonide (InSb) detector does have a unique combination of properties which makes it the primary choice for certain applications.

Uncooled photoconductive InSb detectors are sensitive out to longer infrared wavelengths than any other uncooled detectors with the exception of thermistor bolometers or thermocouples, which are approximately a thousand times slower in response time than InSb. The spectral response of these InSb detectors is shown in Fig. 1.

Cooled InSb photoconductors are roughly ten times

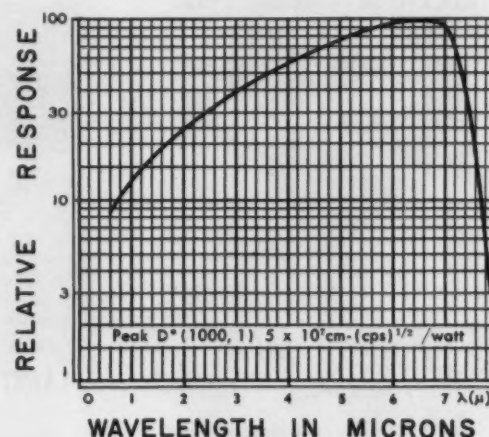


FIG. 1. SPECTRAL RESPONSE of a photoconductive InSb detector at room temperature.

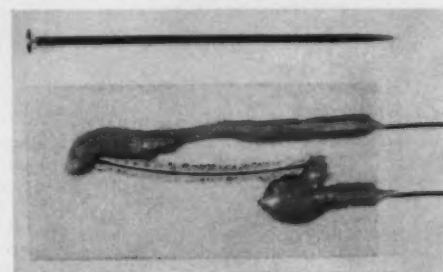


FIG. 2. CURVED Indium Antimonide Detector is compared for scale with common pin.

more sensitive than the uncooled detectors, but the cooled detectors have their spectral peak at 5.5μ and are nearly blind at 6μ.

Their rapid response time (less than 1 μsec), makes InSb photoconductors particularly suitable for such applications as rapidly scanning a spectrum in a spectrometer, a picture in an imaging device, or following very rapid events such as flashtubes or lasers. This cell in Fig. 2 is only 0.0006" wide and 0.7" long. Produced by Block Associates, Inc., Cambridge 39, Mass., it is used as an exit slit of an Ebert spectrometer.

FOR MORE INFORMATION CIRCLE 182 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

CM8-680 — famed for long life...now specified for military equipment!

Computations, based on accelerated life tests, indicate that this lamp will burn for 1,000,000,000 years! Unfortunately none of us will be around to prove it! However, we do know that the CM8-680 series lamps that were originated in our laboratories, are widely recognized for their unflinching reliability and exceptionally long life.

Because of these qualities, the CM8-680 series is now specified for military use (MS24367 and MS24515). The Chicago Miniature Lamp Works is the prime source for this type of lamp.

Suppliers to military services, producing equipment that incorporates ultra-miniature lamps, can be sure of compliance to specifications by ordering these lamps by these MS numbers.

For complete specifications on these and other ultra-miniature lamps—

CHICAGO MINIATURE LAMP WORKS
1553 No. Ogden Avenue Chicago 10, Illinois
CIRCLE 40 ON READER-SERVICE CARD



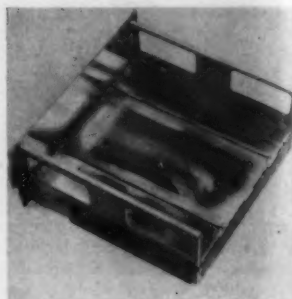
ULTRA-MINIATURE LAMPS
MILITARY STANDARDS NUMBERS

Midsize Flange Base
MS-24515-682 MS-24515-682AS-15
MS-24515-685 MS-24515-685AS-15
MS-24515-714 MS-24515-714AS-15
MS-24515-718 MS-24515-718AS-15

Unbased—Wire Terminals
MS-24367-680 MS-24367-680AS-15
MS-24367-683 MS-24367-683AS-15
MS-24367-713 MS-24367-713AS-15
MS-24367-715 MS-24367-715AS-15

Note: Chicago Miniature's lamps are preceded by prefix CM8, e.g., MS-24367-715AS-15 is Chicago Miniature's CM8-715AS-15.

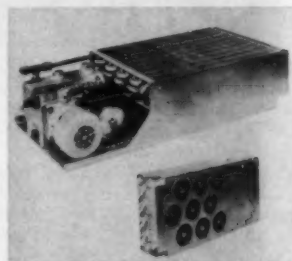
MODULAR CHASSIS



New 17" wide chassis fitting standard 19" racks provides mounting of up to 7 separate circuits in same drawer. Different bottom-plate combinations permit inspection or circuit changes of any circuit without affecting others.—*Chassis-Trak, Inc.*, 525 So. Webster, Indianapolis 19, Ind.

CIRCLE 183 ON READER-SERVICE CARD

HI-CAPACITY COOLING PACK



New airborne heat transfer system E/HT200-214 uses ethylene-glycol/water coolant to achieve 3400 watt capacity over ambients from -55°C to +55°C and from zero to 50,000 ft altitude. Weighs 25 lbs and uses 208 v, 3-phase 400 cps power.—*Eastern Industries, Inc.*, 100 Skiff St., Hamden, Conn.

CIRCLE 184 ON READER-SERVICE CARD

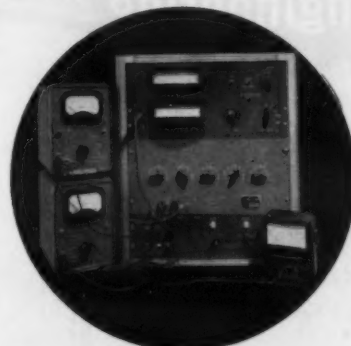
FLAT CONTOUR CABLES



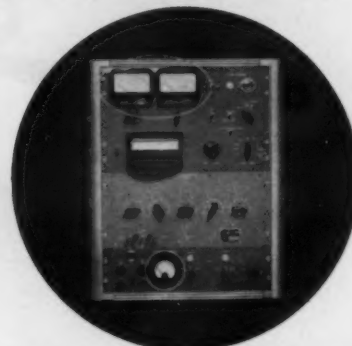
Missile waistlines are reduced by new contour cables which imbed flat metallic strips in plastic dielectric ribbon, weighing 36.6% less than same capacity of conventional cable, providing better dissipation of heat.—*Hughes Aircraft Co.*, Florence Ave. & Teale St., Culver City, Calif.

CIRCLE 185 ON READER-SERVICE CARD

CUSTOMIZE EFFICIENCY & ACCURACY WITH **trio/lab** BUILD-IN INSTRUMENTS...



BEFORE . . . 3 external instruments were used to measure AC and DC voltages . . . cluttered, tedious, wasteful, subject to error.



AFTER . . . 3 trio/lab miniature VTVMs integrally built-in now are always on hand to measure just the parameters you designate.

the industry's pioneer complete line of Miniaturized Electronic Instruments

MILITARY

for MIL-T-21200B &
MIL-T-945A applications.

Model 102
(formerly B series)
ruggedized
single-range
AC VTVMs \$160.



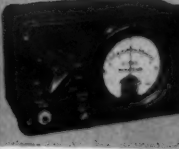
Model 103
(formerly D series)
ruggedized
multi-range
AC VTVMs \$272.



Model 106
(formerly G series)
ruggedized
single or
multi-range
DC VTVMs
from \$136.



Model 107
(formerly J series)
ruggedized
low-level
multi-range
DC VTVMs \$450.



COMMERCIAL

Model 104
(formerly E series)
Single-range AC
VTVMs \$99.50



Model 109-1
low-level
multi-range
AC VTVM \$199.



Model 105
(formerly F series)
single or
multi-range
DC VTVMs
from \$84.50



Model 130-1
1% accuracy
AC VTVM \$150.



By building-in trio/lab panel-mounting instruments you . . . customize test systems, set-ups and instruments; save space (average model is 4" x 4" x 4"); save time with at-a-glance monitoring; save money; make monitoring foolproof ("go/no-go"); improve system reliability; increase overall design freedom. Choose from many "standard" or "special" models — or consult us for new designs for your needs. Write for free "how to" Engineering Guide.

trio/lab

TRIO LABORATORIES, INC.,
Plainview, Long Island, N. Y. • TWX HKVL 1168
Overbrook 1-9400 Area Code 516
Export: EMEC, 127 Grace St., Plainview, N. Y.

CIRCLE 42 ON READER-SERVICE CARD

TRANSMISSION INFRARED

(Sample 1 mm. thick)

92% at 3 microns
50% at 6 microns

Complete facilities
for fabricating all
hard materials to your
exact requirements

Lenses, windows and domes fabricated from synthetic sapphire have outstanding infrared, ultra-violet and microwave transmission characteristics. Synthetic sapphire (Al₂O₃) is particularly applicable to optical systems requiring resistance to abrasion and chemical attack, high temperature properties and wide transmission band. Specialists in the fabrication of synthetic sapphire since 1947, Industrial Sapphire Company has unique facilities for forming it to close specifications. Ask for further information.

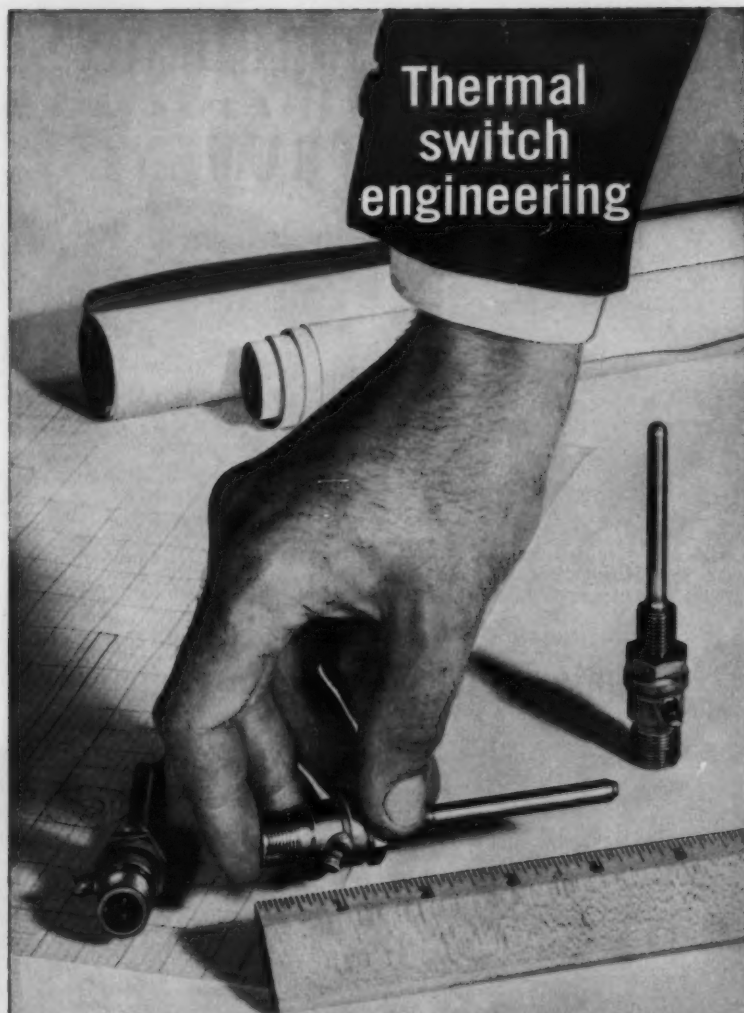
* "Linde" Synthetic Sapphire

INDUSTRIAL SAPPHIRE CO.
P. O. BOX 4226, QUAKERTOWN, PA. Phone: KE 6-3508

CIRCLE 61 ON READER-SERVICE CARD

May-June, 1961

Thermal switch engineering



CPI RESEARCH CREATES A NEW "SHORT HEAD" SWITCH

From CPI research comes this new thermal switch with the shortest head construction of any AN connector type switch. This hermetically sealed, field adjustable, probe type switch was developed for an aircraft manufacturer to control inlet air temperature for heating and turbine exhaust temperatures for air conditioners.

There are other uses, too—controlling temperatures of gas turbines and heat exchangers or oil in gear boxes—in fact, many places where there's need for a hermetically sealed switch with a fast, easy electrical connection. It is possible that this or the many others developed by CPI specialists may not solve your problem. If not, CPI research can create the switch that will! Send your specs.

This new switch is constructed of all high temperature alloys and has a calibration range of -20F to 1750F with safe momentary overshoot to 2000F and undershoot to -100F. It is available in a variety of threaded and plate mountings. Mention "Spec-Stat" when inquiring.



CONTROL PRODUCTS, INC.

274 Ridgedale Ave., Hanover, N.J.

CIRCLE 43 ON READER-SERVICE CARD

FUEL ORIFICE



New standard dual orifice nozzle for gas turbine engines is available for quick engine tests or small quantities where special designs are not warranted. Complete performance information available.—R. J. Slezak, S. M., Delavan Mfg. Co., West Des Moines, Iowa.

CIRCLE 186 ON READER-SERVICE CARD

PLASTIC PROTECTORS



Protection of rectangular miniature electronic connectors during manufacture, shipment and storage is provided by new series of vinyl caps which keep out moisture, dust and contamination, and protect against physical damage during assembly.—Plastics Dept., S. S. White Industrial Div., 10 East 40th St., New York 16, N. Y.

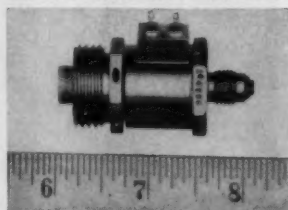
CIRCLE 187 ON READER-SERVICE CARD

SWITCHING TRANSISTOR

New Type 2N781 germanium Transistor, epitaxial mesa unit, has maximum switching time of 110 μ sec, is "world's fastest." Max turn-on time 60 μ sec, max turn-off time 50 μ sec, max storage time 20 μ sec. Saturation voltage of -0.16 v max, "lowest in existence."—Sylvania Electric Products, Inc., Subs. General Telephone & Electronic Corp., 730 Third Ave., New York 17, N. Y.

CIRCLE 188 ON READER-SERVICE CARD

AXIAL SHUTOFF VALVE



New axial flow shutoff valve surpasses minimum leakage requirement of 1 cc/hr for deep space probe application. Operates on 2 watts power at 24 v dc against 15 psi over the -148°F to 212°F range.—Whittaker Controls Div., Telecomputing Corp., 915 N. Citrus Ave., Los Angeles, Calif.

CIRCLE 189 ON READER-SERVICE CARD

Transistorized Logic Circuits

Basic modular circuits including AND gates, OR gates, Emitter Followers and Inverters are available in both single and dual circuits with PNP, NPN or Complementary Symmetry circuits. Self-compatible and mutually compatible with many other Walkirt off-the-shelf modules, they are miniature plug-in units fully encapsulated for complete environmental protection and reliability (Fig. 1 shows actual size).

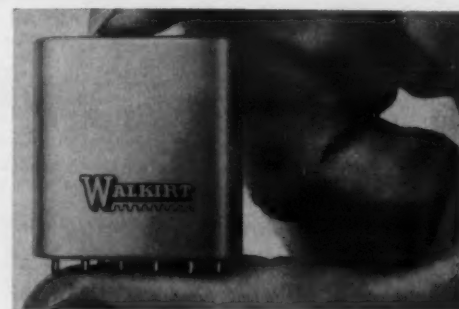


FIG. 1. ENCAPSULATED PLUG-IN dual symmetry logic circuit uses two NPN, two PNP transistors, providing low output impedance to both positive- and negative-going steps.

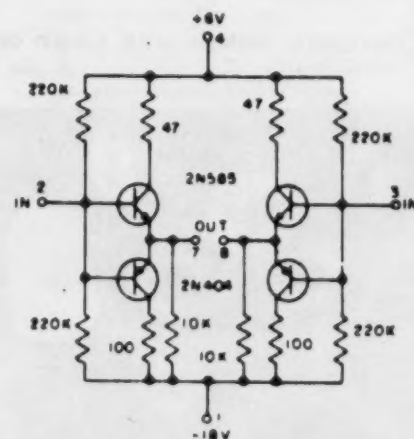


FIG. 2. DUAL COMPLEMENTARY emitter follower Model PM8333 schematic circuit.

Emitter followers are used to match a higher impedance to a lower impedance, such as might occur when using a binary counter to drive several circuits in parallel. Standard emitter follower circuits are available in PNP, NPN or complementary symmetry types with each type in either single or dual packaging. The circuit of the dual complementary symmetry type, Model PM8333 is shown in Fig. 2.

PNP emitter followers have a low impedance output to a negative-going step, but the output impedance to a positive-going step is equal to the emitter follower load resistance, which may be several times the load resistance. (From new 4-page technical brochure No. 12211, Walkirt Company, 141 W. Hazel St., Inglewood, Calif.)

FOR MORE INFORMATION CIRCLE 190 ON READER-SERVICE CARD
MILITARY SYSTEMS DESIGN



Quality is a big word at RAPID ELECTRIC

From engineering design and development to final production and shipment RAPID maintains strict control over its high quality.

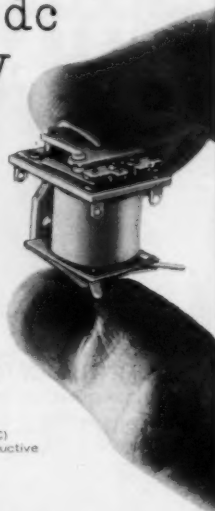
- (1) NEMA standards strictly maintained.
- (2) Transformers, reactors, magnetic amplifiers, meter shunts, and selenium stacks designed and produced by RAPID, insures quality control.
- (3) Years of skillful engineering, production methods and test facilities assure rigid high quality standards will be upheld.

Regardless of application, RAPID is interested in your dc power requirements. Why not send your inquiry in today? Write or call TA 8-2200.

Catalog and descriptive brochures available upon request.

RAPID ELECTRIC CO., INC.
2881 MIDDLETOWN ROAD • NEW YORK 81, N.Y. • TAlmadge 8-2200
PLANTS: (4) NEW YORK, N.Y. • GRAYSBRIDGE ROAD, BROOKFIELD, CONN
CIRCLE 64 ON READER-SERVICE CARD

a low cost miniature dc dpdt relay



The Elgin Advance MK Series relay pictured above in actual size, occupies less than 1/2 cubic inch and is priced surprisingly low when ordered in quantity. The MK relay is available in a variety of DC coil voltages and enclosures. The switching circuit is insulated from the relay frame with silicone glass, assuring an above ground condition.

Specifications

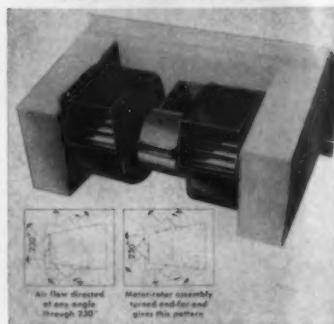
Contact arrangements: SPDT(1C), DPDT(2C)
Contact rating: 1 amp resistive, 0.6 amp inductive
Nominal power:
SPDT: 0.75 watt nominal
DPDT: 1 watt nominal
Size: 51/64" x 31/32" x 5/8", maximum
Weight (open): 11 grams, maximum
Enclosures: Open, dustite, hermetically sealed
Mounting: Screw, stud, octal plug

SEND FOR LATEST DATA

ELGIN advance RELAYS
THE ELECTRONICS DIVISION OF ELGIN NATIONAL WATCH COMPANY
2435 NORTH WABRI STREET, BURBANK, CALIFORNIA

CIRCLE 65 ON READER-SERVICE CARD

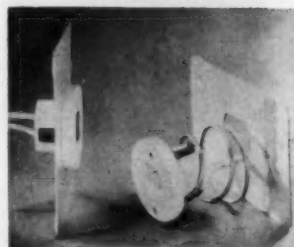
ALL-ANGLE BLOWER



New 400 cfm twin blower adjusts its scrolls to any angle through 230° or creates new air pattern by reversing motor-rotor assembly end-for-end in housing.—*Western Devices, Inc.*, 600 W. Florence Ave., Inglewood 1, Calif.

CIRCLE 191 ON READER-SERVICE CARD

"SNAP-IN" FLUORESCENT SOCKETS



New Kulka Type 582-583 recessed contact lampholders rated at 600 v, 660 watts, are quickly snapped-in from the front without dismantling fixtures. Lead wires are deeply recessed so that no pitch is needed in outdoor signs or fixtures.—*Kulka Electric Corp.*, 633-643 So. Fulton Ave., Mount Vernon, N. Y.

CIRCLE 192 ON READER-SERVICE CARD

CHARACTER GENERATOR



New Curviline® Solid State Character generator combines continuous straight and curved lines to form all digits, letters and many symbols, at rates to 50,000 characters per second. Packaged in a fully transistorized compact 4" x 6" x 7" cabinet, it can be used with any CRT display, including radar scopes.—*RMS Associates, Inc.*, 805 Mamaroneck Ave., Mamaroneck, N. Y.

CIRCLE 193 ON READER-SERVICE CARD

HIGH ACCURACY TRANSDUCER INSTRUMENTATION SYSTEMS

- Multi-Channel Strain Gage Plotters
- Weighing Systems
- Thrust Measuring Systems
- Digital Indicators
- Data Loggers
- Calibration Equipment

FOR . . . LOAD CELLS

- Tank, Hopper and Batch Weighing
- Thrust Measurement
- Load Cell Calibrators
- Rocket Engine Weight and C.G.

STRAIN GAGES

- Multi-Graphic Plotters
- Data Loggers

THERMOCOUPLES

- Data Loggers
- Segmental Recorders

PRESSURE TRANSDUCERS

- Readout and Control Systems
- Calibrators

For specific information on any type of Gilmore System, write Dept. S



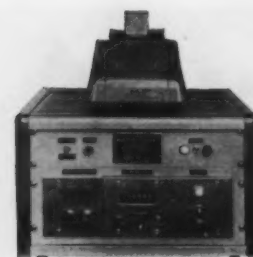
Instrumentation Systems for Industry and Science
INDUSTRIES, INC.

13015 Woodland Ave. • Cleveland 20, Ohio • RAndolph 1-6400

East Coast Sales & Service Office: Box 531 • Media, Pa. • L OWell 8-7228

West Coast Sales & Service Office: 2550 East Foothill • Pasadena, Calif. • M Urray 1-8348

CIRCLE 66 ON READER-SERVICE CARD



M176
Digital
Indicator
&
Printer



M243
Digital
Indicator
&
Recorder



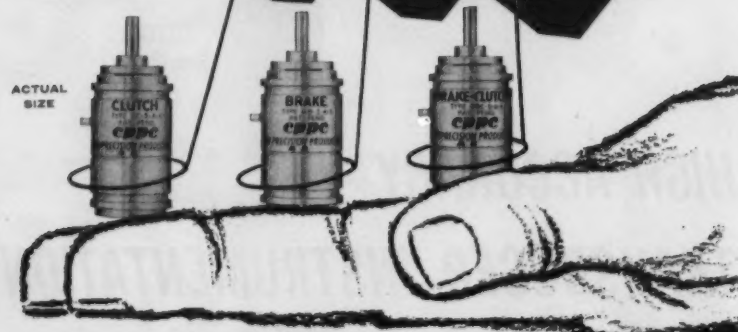
20 Channel
Per Second
Strain Gage
Plotter



M170
Load Cell
Calibrator

NEW

FROM
CLIFTON
PRECISION



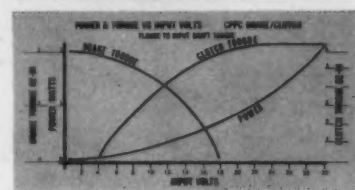
- GUARANTEED "NO-CREEP" DESIGN (pat. pend.)
- HIGHEST TORQUE PER WATT
- NO LOSS OF TORQUE DURING LIFE (torque tends to increase)
- NO TORQUE VARIATION WITH TEMP.
- OFF-SHELF DELIVERY

Well known as the quality manufacturer of highest accuracy and reliability synchros and rotary components, CPCC has now added to its line a series of optimum performance free clutches, brake-clutches and brakes.

These clutches were designed and fabricated for use in our Systems Division's Analog Navigation Computers as a suitable clutch could not be procured for sustained in-flight operation. They are designed to MIL-S-20708 and meet requirements of MIL-E-5400 and MIL-T-5422.

Write or call today for full information on these rugged size 5 components.

SPECIFICATIONS	
Weight	0.97 Ounces
Minimum Engagement Voltage	6 Volts D.C.
Power Consumption	1.6 Watts at 28 Volts
Response Time at 28 Volts D.C.	2.8 Milliseconds
Inductance	0.33 Henries
Torque at 28 Volts D.C. Excitation	
Clutch	
Engaged (Minimum)	6.0 Ounce inches
Disengaged (Maximum)	0.95 Ounce inches
Brake	
Brake Torque (Minimum)	2.0 Ounce inches
Polar Moment of Inertia	
Engaged	1.13 gm-cm ²
Disengaged	0.78 gm-cm ²
Bucklash—Engaged	0 Minutes of Arc
Temperature Rise at 25° C	30° C



CLIFTON PRECISION PRODUCTS CO., INC.

Sales Department: 5050 State Rd., Drexel Hill, Pennsylvania
MADison 2-1000, TWX LNSDWH, PA. 1122(U)—or our Representatives

CIRCLE 67 ON READER-SERVICE CARD



STAINLESS SOLENOID



New stainless steel solenoid for use in cryogenic and missile fuel control resists corrosion even indirect contact with oxidizers and missile fuels. Only 1" dia by 1 3/4" long it delivers 10% lb forces at 0.020" stroke at 24 v dc, over temperatures from -420° to 500°F.—Electroid Corp., 95 Progress St., Union, N. J.

CIRCLE 194 ON READER-SERVICE CARD

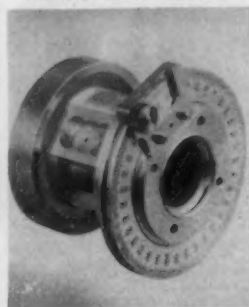
AXIAL SILICON RECTIFIER



New double diffused axial type silicon rectifier in a hermetically sealed insulated body is only 0.425" long by 3/8" dia, with ratings from 5 to 1,200 v PIV and up to 6 amperes. Exceeds most requirements of MIL-STD-E/1084.—Solitron Devices, Inc., 500 Livingston St., Norwood, N. J.

CIRCLE 195 ON READER-SERVICE CARD

ROTATING PROBE



Circular waveguide rotating probe section provides continuous 360° probe rotation for measuring electrical field mode orientation. Probe locks at three longitudinal positions, protractor scale reads rotation to 1/2° accuracy.—Applied Microwave Electronics, Inc., 114 West 25th St., Baltimore 18, Md.

CIRCLE 196 ON READER-SERVICE CARD

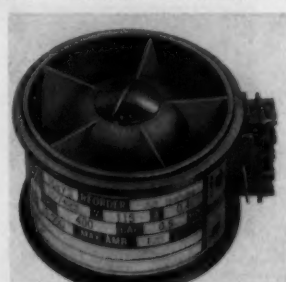
CAVITY AMPLIFIERS



New UHF-VHF miniature Cavity Amplifiers for aerospace and ground support applications and using 7552 and 7554 coaxial pencil triodes can be ordered in six output frequency ranges from 215 to 1100 mc. Functions include: Low noise, high gain, power amplifier, frequency doubler and frequency triplers.—Resdel Engineering Corp., 330 Fair Oaks Ave., Pasadena, Calif.

CIRCLE 197 ON READER-SERVICE CARD

SERVO MOUNTED AXIAL FAN



New servo-ring mount is now available for Aximax 2 type fan. Servo mount with fillister head screws permits fan to be removed by loosening screws and slipping servo ring out from under screw assemblies.—Rotron Manufacturing Co., Inc., Woodstock, N. Y.

CIRCLE 198 ON READER-SERVICE CARD

"Cost/Megohm" Calculator for Resistor Wire

New pocket-size graphic calculator . . . provides convenient means of determining megohms-per-pound and cost-per-megohm of enameled 800 ohm nickel-chromium and 815 ohm iron-chromium-aluminum precision resistor wire. Free slide chart covers wire sizes

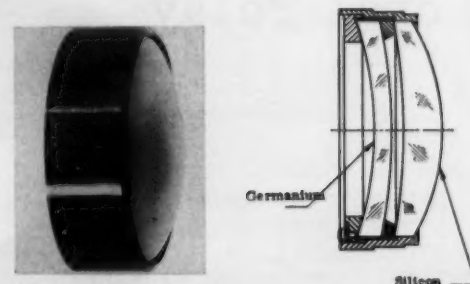
Enameled Resistor Wire COMPARATOR			
WIRE SIZE	800 OHM Ni-Cr Alloys	ALLOY 815-R	Comparative Advantages
.0013"			
Price per Pound	\$171.15	\$157.64	7.9% Less
Megohms per Pound	94.680	107.900	14% More
Cost per Megohm	\$1.81	\$1.46	19.3% Less

ranging from .0031" down to and including .0004" diameter. To use the chart simply select the wire size desired and read out current comparative data shown for both types of wire . . . (Hoskins Manufacturing Co., 4445 Lawton Ave., Detroit 8, Mich.)

FOR MORE INFORMATION CIRCLE 199 ON READER-SERVICE CARD

IR Achromatic Range Extended

Computer techniques are being used by Servo Corporation of America, Hicksville, N. Y., to optimize design and speed fabrication of Servocon® lenses to user



COMPUTER-OPTIMIZED IR Lens Computations, using refractive indices of germanium and silicon provide a "best fit" for the spectrum required by each customer.

specifications. Previously available only in the 1-6 μ range, the new lenses combine elements of germanium and silicon to give high resolution and improved optical performance throughout the 1-14 micron spectrum. Recent developments at Servo in developing new IR transmitting glasses promise still further developments in high performance IR refractive optics.

FOR MORE INFORMATION CIRCLE 200 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

Tavis
ENGINEERING
De Ceducer

ACCURACY
0.1%

DC-IN DC-OUT
VARIABLE RELUCTANCE
TRANSDUCER

Series 400



5 psi to
5000 PSI
Differential
absolute
or gage
45 VDC
max. input

TELEMETRY
INDUSTRY
AIRCRAFT
MISSILES

0 to 5 VDC
output into
100K or
greater load
4000 ohms
nominal
output
impedance



Tavis
ENGINEERING

1711 SO. MOUNTAIN AVE.
MONROVIA, CALIF.

SEND FOR
LITERATURE
TAVIS IS A DIVISION OF EDCLIFF
INSTRUMENTS, MANUFACTURERS OF
A COMPLETE LINE OF AC AND DC TRANSDUCERS

CIRCLE 68 ON READER-SERVICE CARD

NOW - A MAJOR BREAKTHRU -
500 WATTS OF
REGULATED
DC POWER
IN 5 1/4 INCH PANEL



FEATURES OF RV500 SERIES

Input: 105 to 125V, 57-63 cps, 1 ϕ

- Overload and short circuit protection
- Dimensions: 19" w x 5 1/4" h x 13" d
- Reversible and floating output
- Fast response
- Fully metered
- Weight: 65 lbs.

MODEL SCR	OUTPUT		STATIC REGULATION		RIPPLE
	VOLTS	AMPS	105V-125V Line	N.L. to F.L.	
32V-15A-1	0-32	0-15	.1% or 30MV	.1% or 30MV	2MV RMS
60V-7.5A-1	0-60	0-7.5	.1% or 60MV	.1% or 60MV	3MV RMS

MODEL SCR	OUTPUT		STATIC REGULATION		RIPPLE
	VOLTS	AMPS	105V-125V Line	N.L. to F.L.	
32V-15A-1	0/16	16/32	0-15	.5% or 150MV	200MV RMS
60V-7.5A-1	0/30	30/60	0-7.5	.5% or 300MV	400MV RMS

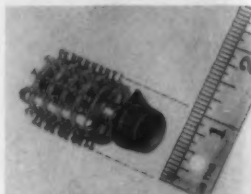
Write for data!

DEL ELECTRONICS CORP. MOUNT VERNON, N.Y.
521 Homestead Avenue Telephone: OWens 9-2000

CIRCLE 69 ON READER-SERVICE CARD

May-June, 1961

SUB-MIN ROTARY SWITCHES



New MIL-Type Series 7000 (12 contacts/deck) and 5000 (24 contacts/deck) are available in shorting and non-shorting types in many contact arrangements. MIL-quality materials include epoxy-glass fabric laminations, Steatite rotor meeting MIL-I-10A, silver wafer contacts, gold plated.—J-B-T Instruments, Inc., 133 Hamilton St., New Haven 8, Conn.

CIRCLE 201 ON READER-SERVICE CARD

HI-GAIN POWER TRANSISTORS



New line of silicon NPN transistors with power gains up to 1000 are available in series WX118X with minimum guaranteed current gain to 400 at 10 amps, and WX118U with minimum gain of 100 at 10 amps. Both are made with V_{ce} ratings of 50, 100 and 150 volts.—Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa.

CIRCLE 202 ON READER-SERVICE CARD

EPOXY REPAIR PENCIL



Now available for quick permanent bonds in most situations requiring cementing, sealing and insulating, the Cetron Epoxy pencil spreads at 200°F, cures in 7 minutes at 420°F to 12 hours at 245°F. Bonds metals, ceramics, glass, fiberglass and plastics.—Cetron Electronic Corporation, Plastics Div., 2265 E. Foothill Blvd., Pasadena, Calif.

CIRCLE 203 ON READER-SERVICE CARD

John
Brogan
can
show
you...



how to match a PAV to tough GSE specs

From its all solid state circuitry to its MIL-type hermetically-sealed meter and plug-in amplifiers, every design feature of the Model VM-235 Phase Angle Voltmeter has been selected for rigorous service in Aerospace Ground Equipment.

Your North Atlantic man can quickly demonstrate how this rugged, miniaturized version of North Atlantic's famous PAV provides direct, accurate reading of phase angle, nulls, total, fundamental, quadrature and in-phase voltages—even under the roughest of military field conditions.

The VM-235's ability to meet tough system specs is demonstrated daily in operational and support equipment for USAF and Navy aircraft and missile programs. Its capabilities for complex measurements are shown in the abridged specifications below:

Voltage Range.....	1 mv to 300 v f.s., 12 ranges
Voltage Accuracy.....	±2% f.s.
Phase Accuracy.....	dial: ±1°; meter: ±3% of F.S. degrees
Signal Frequency.....	400 cps
Input Impedance.....	1 megohm
Reference Input.....	26 v or 115 v
Meter scale.....	3-0-3, 10-0-10 linear
Phase Angle Dial.....	2 scales, 90° (elec.) apart
Nulling Sensitivity.....	2 microvolts (phase sensitive)
Harmonic Rejection.....	55db (with filters)
Dimensions.....	8 1/8" h. x 8 1/2" w. x 6 1/8" d.

North Atlantic's field engineering representative in your area has full data on the VM-235, as well as modified versions for specific systems requirements. For his name, call or write today, or request Bulletin VM-235.



NORTH ATLANTIC industries, inc.
TERMINAL DRIVE, PLAINVIEW, L. I., NEW YORK • Overbrook 1-8600

CIRCLE 70 ON READER-SERVICE CARD

New f/2.3 ZOOM LENS

For 16mm FASTAX High Speed Motion Picture Cameras



- Complete versatility with only one lens . . . 28mm to 75mm
- Critically sharp throughout focal range . . . 1" to 3"

The Wollensak Varifocus Zoom Lens increases the effectiveness of the Fastax by permitting various degrees of wide angle and telephoto coverage with one lens . . . always with you, ready for action. Crisp, clear images anywhere in the focal range. Aperture of f/2.3 throughout the entire focusing range of 5 feet to infinity. Calibrated focal lengths, distance and aperture markings.

ALSO 20-60mm f/1.8 Varifocus Zoom for C mount cameras.

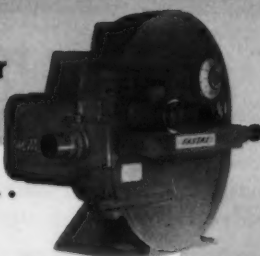
WF-220

400' 16mm FASTAX CAMERA

Combined Motion Picture and High Speed Oscillographic Recorder with STOP-START Capability

SPECIAL 2-sided Prism Delivers . . .

- Even Density over Full Frame
- High Corner-to-Corner Resolution
- Faster Stopping Action



WF 145T

With stop-start feature FASTAX cameras can be rapidly stopped at any point permitting multiple runs throughout 400 foot roll. Operable at any frame rate.

The WF 145T Camera stops action faster with clearer pictures at a given frame rate . . . up to 6,000 pps.



Write for literature on Fastax Cameras, Zoom Lens

WOLLENSAK
OPTICAL COMPANY, ROCHESTER 21, N. Y.

CIRCLE 71 ON READER-SERVICE CARD

TACHOMETER GENERATOR



New Model SU-780D-1 45v 1000 rpm tachometer generator achieves increased output by increased armature length, keeping inertia at a minimum. Is 1 1/4" diameter by 3 1/2" long. Stainless steel shaft has bearing fitted with neoprene seal to exclude contaminants and cover encloses output terminals.—Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J.

CIRCLE 204 ON READER-SERVICE CARD

SYNCHRO-RECEIVER-BRAKE



New MIL-type Synchro-receiver has integral brake which closes to lock receiver in position, causing the receiver to act as a transmitter. Receiver is 26v 400 cps synchro with 1.5° accuracy under all conditions and integral brake solenoid for 35 vdc or 115 vdc.—John Oster Mfg. Co., Avionic Division, Racine, Wisc.

CIRCLE 205 ON READER-SERVICE CARD

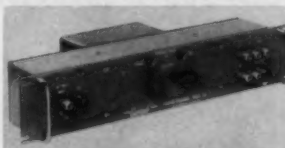
CIRCULAR TRANSFORMER



New Gulow Y-core construction saves vital weight in three-phase aircraft transformers. Thermic interchange of heat between phases is minimized and interphase symmetry improved by new technique.—Gulow Transformer Co., Inc., Carlstadt, N. J.

CIRCLE 206 ON READER-SERVICE CARD

SYNCHRO TEST STANDARD

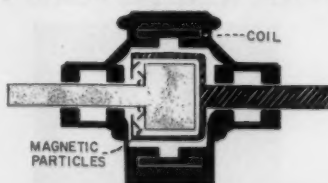


New Models SS-1, 2 and 3 provide stator outputs S₁, S₂ and S₃ corresponding to the outputs of a master synchro as the shaft is rotated in 5° increments. Quadrant switching stimulates operation over 360°.—Gertsch Products, Inc., 3211 South La Cienega Blvd., Los Angeles 16, Calif.

CIRCLE 207 ON READER-SERVICE CARD

MAGNETIC CLUTCH

New dry magnetic particle clutch of 10 lb-ft torque rating consists of inner member enclosed by and rotating within, the outer member. Both members are independently supported by stator bearings and the space be-



tween members is filled with a dry ferromagnetic powder. Until the stator coil is energized, the magnetic particles in the gap have no bonding effect; torque is zero.

When stator coil is energized, the magnetic field produces magnetic particle bonds capable of torque transmission proportional to magnetic field current, up to clutch rating. Clutch slips when this rating is exceeded. Torque transmitted is independent of the relative rotational speed between the inner and outer member. 4-page bulletin EPD 6106-5 gives further data.—Vickers Incorporated, Electric Products Div., St. Louis 3, Mo.

CIRCLE 208 ON READER-SERVICE CARD

Calibrated Variable Attenuators

Calibrated Variable Attenuators are required for power level adjustment in many microwave equipment and laboratory test applications. Three types offered by the Waveguide Division of Microwave Associates, Inc., are well shielded, rugged, economical and operate at temperatures up to 130° centigrade: Type 1—Calibrated Micrometer Drive, Type 2—Calibrated Knob Drive (Fig. 1) and Types 3—Direct Reading, Panel Mounted, Knob Drive.

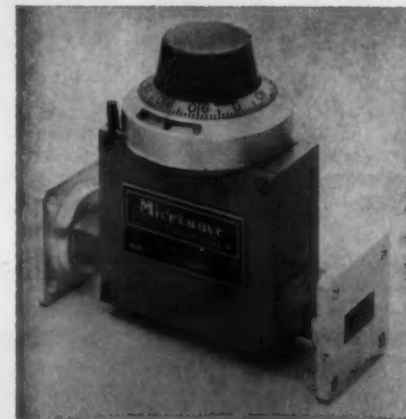


FIG. 1. VARIABLE ATTENUATOR with calibrated knob drive is spring loaded with lever locking device to hold any desired attenuation.

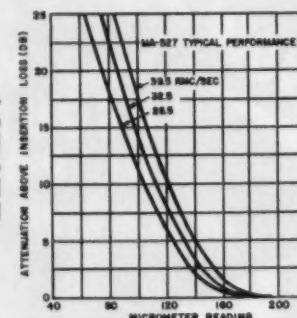


FIG. 2. TYPICAL CALIBRATION curve of attenuation vs. dial reading, accurate to $\pm 1/4$ db, is supplied with each calibrated attenuator.

All three types are single vane "guillotine" type attenuators in which a tapered longitudinal vane of resistive card is inserted into a slot in the center of the wide side of the waveguide. Attenuation is negligible when the card is withdrawn from the waveguide and is maximum when it extends to the opposite waveguide wall. The vane is a thin metallized fiberglass or mica card matched to the waveguide impedance by tapers.

The attenuating vane in Type 1 is controlled by a micrometer mounted atop the control box. This feature assures anti-backlash operation combined with extremely accurate reproducible calibration.

The attenuating vane in Type 2 is controlled by a spring-loaded knob driven tuner. The drive knob contains a lever locking device, permitting locking at any desired value of attenuation.

MILITARY SYSTEMS DESIGN

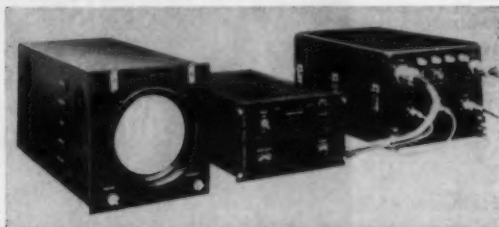
A curve of attenuation vs. micrometer or dial reading, accurate to within $\pm 1/4$ db is supplied with each calibrated attenuator (Fig. 2).

Type 3 is a direct reading (0-25 db) attenuator with a convenient built-in mounting plate. This feature permits easy installation in various amplifiers, analyzers, system applications and other rack or panel assembled devices.

FOR MORE INFORMATION CIRCLE 209 ON READER-SERVICE CARD

Pan Receiver Fits in Small Space

A new panoramic receiver (see Fig.), consisting of a physically independent indicator, a control box and the receiver proper allows the operator easy access to controls, mounting of the indicator scope for best visibility, and installation of the major circuitry where space and accessibility for maintenance are available



PANORAMIC RECEIVER consisting of (left to right) indicator unit, control unit and circuitry box conserves cockpit space, is located for convenient viewing, and combined weight of all 3 sections is only 60 lbs.

as far as 20 feet removed from the indicator and controls. Dimensions of the indicator unit are only 8" x 18" x 8".

The receiver, Model Pan 1F, a development of the Trak Electronics Company, Inc., of Wilton, Conn., contains no moving parts and features an electronic sweep and inertialess tuning. It scans from 100 to 150 mc at 22 sweeps/sec, furnishing on a 5ADP7 cathode ray tube a visual display of all signals broadcast throughout the range being swept. In full sweep, a frequency marker which appears as a step in the base line is controlled either from the front panel of the control box or by tuning the control of a companion listen receiver. In expanded sweep mode, the entire scope is covered by a 1, 5 or 10 mc section of the spectrum with the frequency marker always in the center of the scope, permitting close scrutiny of audio signals.

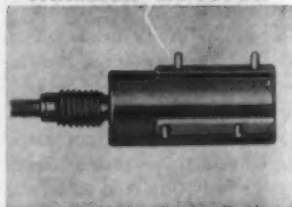
Said to weigh approximately half as much as a conventional panoramic receiver, the unit operates on 375 watts power at 117v $\pm 15\%$, 400 cps. Input impedance is 50 ohms with VSWR of 2.4:1 max, with oscillator re-radiation only 3 μ v max across 50 ohms.

Expanded mode accuracy is ± 300 kc at 1 mc, ± 0.5 mc at 5 mc, and 1.0 mc at 10 mc. Visual resolution for the normal mode is 50 kc and 30 kc in the expanded mode. External marker accuracy when the unit is used with a listen receiver is 100 kc.

FOR MORE INFORMATION CIRCLE 210 ON READER-SERVICE CARD

May-June, 1961

VARIABLE INDUCTOR



A full line of encapsulated variable powdered-iron core inductors, meeting MIL-C-15305 meet the need for tunable RF coils and transformers to ensure reliable operation even after prolonged immersion in water. Data sheets available.—Vanguard Electronics Co., 3384 Motor Ave., Los Angeles 34, Calif.

CIRCLE 211 ON READER-SERVICE CARD

MEDIUM-POWER TRANSISTORS

New high-speed medium power 2N1131 and 2N1132 PNP double-diffused silicon mesa transistors are designed to operate in linear and non-linear complementary symmetry with TI 2N696 and 2N697 NPN transistors. Total switching times of 0.375 μ sec are typical.—Texas Instruments, Inc., Semiconductor-Components Div., P. O. Box 5012, Dallas 32, Tex.

CIRCLE 212 ON READER-SERVICE CARD

COMPACT GANG-POT



New Daystrom 319 Series packs up to 24 precision rotary potentiometers on a single shaft in a 6" length. Also permits individual adjustment without affecting adjoining pots in less than 20 seconds. Meeting all applicable MIL Specs; power rating is 2 watts in still air.—Potentiometer Div., Daystrom, Inc., Archbald, Penna.

CIRCLE 213 ON READER-SERVICE CARD

MULTITURN LIMIT STOP



New SR 3341 servo-mounted multi-turn limit stop, continuously variable from 0 to 42 turns can be adjusted without removing unit from its mount with Allen wrench; weighs under 2-oz.—Components Marketing Div., Reeves Instrument Corp., Garden City, N. Y.

CIRCLE 214 ON READER-SERVICE CARD



A Transducer Two Years Ahead of its Time



A completely new patented pressure sensor concept has been utilized in Servonic's new, low pressure L-96 Transducer. This miniature potentiometer-type unit withstands vibration levels in excess of 35 g's with less than 1% error. Two separate sets of aneroid capsules attached to opposite ends of a driving frame are utilized in the design. One set senses the driving media while the second can be evacuated for an absolute pressure reference, or vented to the atmosphere for gage measurement.

Pressure changes are transmitted through a unique, frictionless, metallic belt linkage system to position the wiper of the precision potentiometer. The fluid filled interior dampens vibration effect, provides long life and minimizes electrical noise. The unit is so insensitive to vibrations, extended dwells are allowed at any vibration frequency. Besides its excellent vibration characteristics, the L-96 has a temperature range of -65° to 275° F and a range of 0-15 to 0-350 psia or g.

For additional information about the wide pressure ranges and mounting configurations available in the L-96, write:

SERVONIC INSTRUMENTS, INC.
Manufacturers of pressure transducers, pressure switches, rectilinear potentiometers and slip ring assemblies.
1644 WHITTIER AVENUE, COSTA MESA, CALIFORNIA

CIRCLE 72 ON READER-SERVICE CARD



...ensures r-f compatibility of new and existing electronic equipment over the frequency range 375 to 1000 mc.

The speed in measuring r-f interference, determining missile range safety, or performing antenna propagation studies with the NM-52A is increased by the 91597-2 Broadband Antenna. This antenna allows rapid scanning over the frequency range with no antenna tuning adjustments required.

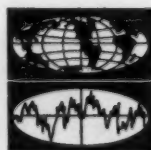
Military specifications approval, as well as many exclusive Stoddart features enable the NM-52A to be used in any application where a highly sensitive frequency-selective microvoltmeter or receiver is required.

APPROVED by Specifications MIL-I-6181D, MIL-I-26600 (U.S.A.F.) and MIL-I-16910B (SHIPS). The NM-52A is available for immediate delivery from stock.

Send for complete information on Stoddart equipment covering the frequency range of 30 cps to 1000 mc.

STODDART
AIRCRAFT RADIO CO., INC.

6644 Santa Monica Blvd., Hollywood 38, Calif.; HOLLYWOOD 4-9292
serving 33 countries in Radio Interference control

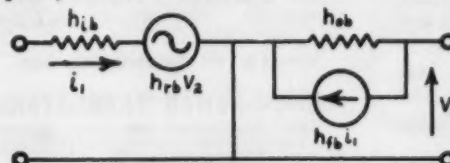


CIRCLE 73 ON READER-SERVICE CARD

Transistor Test Set

The Type 210A Transistor Test Set is completely self-contained and designed for measuring input impedance, voltage feedback ratio, output admittance, emitter-input current gain, base input current gain and collector saturation current. Operation is very simple. Unskilled personnel can, after a minimum briefing, be fully qualified to ascertain basic characteristics of all types of small transistors to 7 ma and 75 volts.

By coupling with a laboratory oscillator and an AC Voltmeter, the parameters of Alpha and Beta cut-off, and Collector Capacitance as well as other high frequency measurements can be made. Circuit per-



formance can be determined with respect to voltage and power gain, matching impedances, frequency response, etc. An equivalent circuit employing these hybrid parameters is illustrated.

Parameters measured are:

h_{ib} — 1 ohm to 1 K

h_{rb} — 0.0001 to 0.1

h_{ob} — 10^{-7} ($r_{22} = 10$ meg.) to 10^{-8} ($r_{22} = 1$ K)

h_{fe} — 0.01 to 100.0

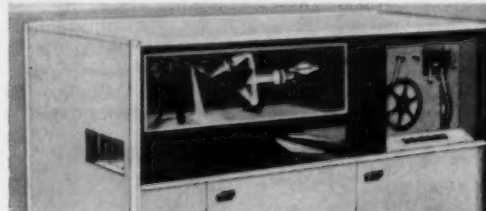
h_{re} — 0.01 to 1000.0

Power requirements: 115 volts, 60 cycles, 35 watts
... (From 4 page brochure, Semiconductor Test Sets,
Owen Laboratories, 55 Beacon Pl., Pasadena, Calif.)

FOR MORE INFORMATION CIRCLE 215 ON READER-SERVICE CARD

Electronic Reading Machine

The Farrington Optical Scanner Model 1P5P ... world's first commercial page reader ... reads upper



and lower case alphabetic characters, common punctuation marks, and numeric characters, 0-9. Model 1P5P has ability either to read full pages of typewritten information, single or double-spaced, or to scan entire pages in search of particular information, further translating it into a punched paper tape code. Whether the 5-level or the 6-level code is used, the page reader scans and punches 240 characters per second, automatically feeding from page to page ... The 1P5P offers automated systems in such areas as communications transmission, type-setting, data reduction, scientific literature abstraction, catalog-indexing and language translation ... (From 4-page bulletin, Farrington Mfg. Co., Needham Hts. 94, Mass.)

FOR MORE INFORMATION CIRCLE 216 ON READER-SERVICE CARD

If
Reliability
is
the
Answer...

If reliability is an important factor, each single component must be precision engineered and accurately produced.

Metal Fabrications by Falstrom have been used in the aircraft and missile fields from their beginning. Falstrom has the facilities and trained manpower to manufacture critical components — chassis, weldments, housings, etc. — in accordance with the most demanding MIL Specs.

Name your own metal — stainless steel, magnesium, aluminum, or one of the new special alloys.

Call or write for descriptive bulletin.

FALSTROM COMPANY
167 Falstrom Court, Passaic, New Jersey
PRescott 7-0013

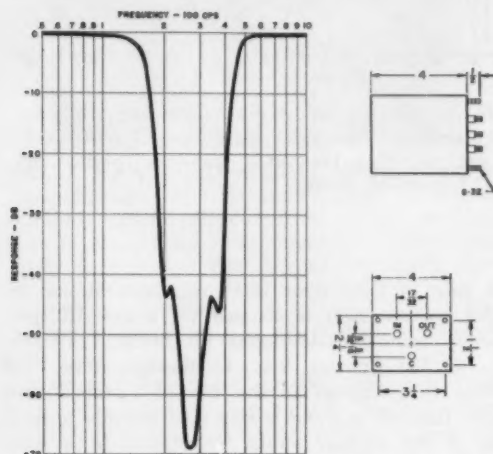
See us at the Design Engineering Show
Detroit—Cobo Hall—Booth 821

CIRCLE 74 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

Computer-Designed Filters Fit Customer's Specifications

Chief design tool used by the Components Corporation, is an IBM 620 Digital Computer, which rapidly performs on command the complex computations necessary to accurately design the specific filter needed to meet their customer's individual requirements.



Specialists in the manufacture of wave filters, toroidal coils and magnetic amplifiers, the Components Corporation have prepared a booklet containing a number of data sheets each of which provides response vs frequency characteristics and other electrical and dimensional data on a specific stock unit, also customer's specification sheets for setting forth parameters on custom-designed magnetic amplifier and filter applications. The response curve for a typical filter Type F-0249 which rejects the 200 to 400 cps band, is shown alongside an outline of the unit. Both the input and output impedance of this unit are 600 ohms. (Booklet free on request to Components Corporation, 2857 No. Halsted St., Chicago 15, Ill.)

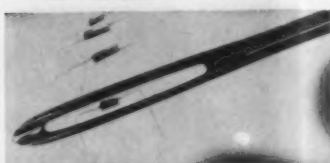
CIRCLE 217 ON READER-SERVICE CARD

BOOK REVIEWS

ELECTRONIC DRAFTING HANDBOOK, by Nicholas M. Raskodoff, (1961), The Macmillan Company, New York 11, N. Y., 402 p., 6" x 9", \$14.75. Shows preparation of every type electronic drawing including schematics, outline, working installation, printed circuit production, industrial control and microwave "plumbing."

LECTURES ON COMMUNICATION SYSTEM THEORY, edited by Elie J. Baghdady (1961), McGraw-Hill Book Co., New York 36, N. Y., 617 p., 6" x 9", \$12.50. Notes and lectures on 23 topics as presented by 18 different lectures to a large group of practicing communications engineers at MIT in August 1959. Described as well-integrated modern approaches to development of new communications systems.

TANTALUM CAPACITORS



New solid-slug TS type tantalum capacitors ranging from 0.01 μ f and 15 v to 20 μ f and 4 v range from only 0.150" to 0.240" in length, making them ideal for microminiaturized applications. Red end denotes positive, white is negative polarity.—*Tansistor Electronics, Inc., West Road, Bennington, Vt.*

CIRCLE 218 ON READER-SERVICE CARD

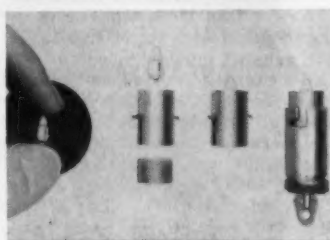
REGULATED POWER SUPPLIES



New Model 170 regulated Power Supply have outputs variable from 10 to 32 volts, 0.25 amps, with regulation better than 3 mv and ripple held to less than 250 μ v. Model 171 characteristics are the same except with output current of 0.50 amps.—*Quantech Laboratories, Inc., 60 Parsippany Blvd., Boonton, N. J.*

CIRCLE 219 ON READER-SERVICE CARD

ULTRAMIN LAMP ADAPTER



New adapter permits use of T-1 ultraminiature lamps in any standard miniature bayonet base socket. Both lamps and adapters in stock.—*Industrial Electronic Engineers, Inc., 5528 Vineland Ave., N. Hollywood, Calif.*

CIRCLE 220 ON READER-SERVICE CARD

LINEAR ACTUATOR



New linear actuator uses dc motor power applied through precision ball screw to provide 500 lb force over a 6" stroke, at a rate of 10"/min. Max tension or compression load is 2500 lbs. Meets MIL-specs for environment and radio shielding.—*Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.*

CIRCLE 221 ON READER-SERVICE CARD

A RUGGED PREM-O-RAK® FOR A RUGGED JOB!

AVAILABLE IN 16 SIZES

FRAME 14 GA. STEEL

END PANELS & DOORS 16 GA. STEEL

COMPLETELY WELDED THROUGH-OUT

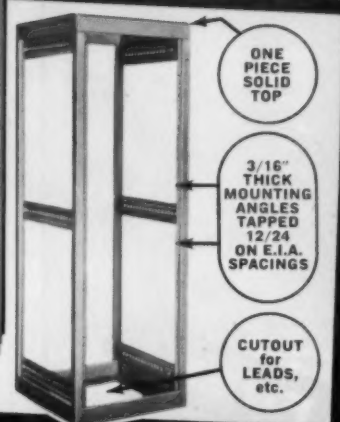


F Series

ONE PIECE SOLID TOP

3/16" THICK MOUNTING ANGLES TAPPED 12/24 ON E.I.A. SPACINGS

CUTOUT for LEADS, etc.



BALL CORNERED MODULAR RACKS 22" and 25 1/2" DEEP for 19" and 24" PANELS

Contact your local distributor or send for complete catalog

PREMIER METAL PRODUCTS CO.

337 MANIDA STREET, NEW YORK 59, N. Y.

WESTERN SALES OFFICE: 1667 Laurel St., San Carlos, California
EXPORT DEPARTMENT: EMEC, 127 Grace Street, Plainview, New York
MFD. IN CANADA by PREMIER METAL HOUSINGS, Ltd., 5810 Smart Ave., Montreal

CIRCLE 75 ON READER-SERVICE CARD

WIDE BAND FM DEVIATION...



... is measured to 3% accuracy with 928 and 928/2. Like all Marconi FM Deviation Meters they have direct readout, xtal standardization and ease of use. They include demodulated output for transmitter noise and distortion measurements.

Most Missile Makers Measure Modulation with Marconi Meters.

	Model 928	Model 928/2
Carrier Freq.	10-500Mc.	215-265Mc
Deviation	to 400 kc	to 150kc
Modulation	50cps-120kc	50cps-120kc
Construction	Shock Resistant, ruggedized, waterproof.	
Price	\$1450	\$1600



MARCONI
INSTRUMENTS



111 CEDAR LANE • ENGLEWOOD, NEW JERSEY

CIRCLE 76 ON READER-SERVICE CARD

EICO 1961

KITS AND WIRED

STEREO
AND MONO
HIGH FIDELITY
TONE INSTRUMENTS
HAND TOOLS
CITIZEN TRANSISTORS
RADIOS

LABORATORY PRECISION AT LOWEST COST

Send for **FREE** New 1961 **EICO Electronics Catalog**

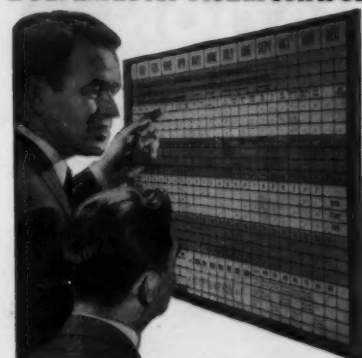
EICO, 3300 N. Blvd., L.I.C. 1, N. Y. MSD-4
☐ Send free 32-page catalog & dealer's name
☐ Send new 36-page Guidebook to HI-FI for which I enclose 25¢ for postage & handling.

Name _____
 Address _____
 City _____ Zone _____ State _____

EICO 3300 N. Blvd., L.I.C. 1, N. Y.
 ...praised by the experts
 as BEST BUYS IN ELECTRONICS

CIRCLE 77 ON READER-SERVICE CARD

You Get Things Done With Boardmaster Visual Control



- ☆ Gives Graphic Picture of Your Operations—Spotlighted by Color
- ☆ Facts at a glance — Saves Time, Saves Money, Prevents Errors
- ☆ Simple to operate — Type or Write on Cards, Snap in Grooves
- ☆ Ideal for Production, Traffic, Inventory, Scheduling, Sales, Etc.
- ☆ Made of Metal. Compact and Attractive. Over 500,000 in Use

Full price \$49⁵⁰ with cards

FREE 24-PAGE BOOKLET No. MT-20
Without Obligation

Write for Your Copy Today
GRAPHIC SYSTEMS
 Yanceyville, North Carolina
 CIRCLE 78 ON READER-SERVICE CARD

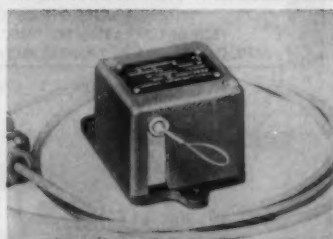
DC RATE GYRO



New Inverter-Demodulator rate gyro regulates, inverts and feeds 28 v dc input to ac gyro motor and microsyn-type pickoff. Output demodulated, balanced, gain-adjusted and filtered, providing up to 12-v dc. Resolution below 0.05%, insensitive to 100-G shock; withstands 30-G vibration up to 2000 cps.—Aircraft Instrument Div., R. C. Allen Business Machines, Inc., 333 Commerce Ave., Grand Rapids, Mich.

CIRCLE 222 ON READER-SERVICE CARD

POTENTIOMETER TRANSDUCER



New transducer measures separation rate between missile or rocket parts in flight. Flexible cable rotates multiturn pot but falls free when fully extended.—Research, Inc., Box 6161, Minneapolis 24, Minn.

CIRCLE 223 ON READER-SERVICE CARD

COAXIAL TERMINATION



New 10-watt Model T-130 50-ohm precision coaxial termination for use over the dc to 10 kmc range can be supplied with type N, C, TNC, BNC male or female connectors. VSWR with type N connectors is 1.1 max from dc to 1 kmc, to 1.3 from 4 to 10 kmc.—RLC Electronics, Inc., 805 Mamaroneck Ave., Mamaroneck, N. Y.

CIRCLE 224 ON READER-SERVICE CARD

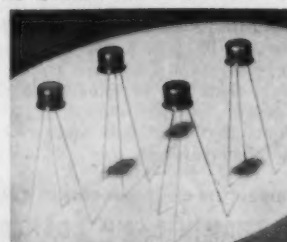
FILM CAPACITORS



New subminiature Teflon Capacitors have low temp coefficient, high stability for critical guidance systems in spacecraft and missiles. Units have self-healing characteristics of metallized film capacitors, for high reliability, but are superior in performance to metallized film and conventional Teflon foil capacitors. Tolerances to 0.1%.—Component Research Co., Inc., 3019 S. Orange Dr., Los Angeles 16, Calif.

CIRCLE 225 ON READER-SERVICE CARD

MIL-QUALIFIED TRANSISTORS



New silicon mesa transistors meeting requirements of MIL-T-19500/74 for general purpose, medium power, fast-switching provide low input impedance, low collector capacitance (typical 14 pF), from 10 μ A to 500 ma operating range and 4 watt power dissipation are designated USN 2N497, -498, -656, and -657.—Rheem Semiconductor Corp., 350 Ellis St., Mountain View, Calif.

CIRCLE 226 ON READER-SERVICE CARD

DC-DC CONVERTER



New submin HV dc-dc converter designed for IR detector tube excitation and other uses operates from 1.3 v mercury battery for more than 250 hr continuous to give outputs 12 kv to 16 kv.—Dept. KP, Telex Special Products Div., Telex, Inc., 1633 Euclid St., St. Paul, Minn.

CIRCLE 227 ON READER-SERVICE CARD

Interference Spectroscopy for Infrared

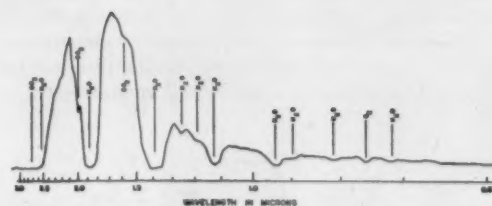


FIG. 1. SPECTRUM of the Moon using PbS detector; 8 cm aperture, glass optics, 1.5° field; 6 sec recording time at 3 scans/sec; approx. 54 cm^{-1} resolving power.

A gain of more than 1000 over conventional infrared spectrometers is claimed for a new IR spectroscopy technique developed by Block Associates, Inc., of 385 Putnam Ave., Cambridge, Mass. The method is analogous to the use of a sound tape played through a wave analyzer to provide a spectrum of the various audio frequencies in a complex musical chord.

If transducers were fast enough, the argument runs, the same method could be used to record electromagnetic radiations. However, since IR transducers are too slow, the waves must in effect be slowed down. This is accomplished by using an interferometer. The fringe pattern produced by introducing a monochromatic light through the interferometer is essentially a "still" picture of that light frequency. When one of the mirrors of the interferometer is moved back and forth at a constant velocity the picture "move" producing an alternate brightening and darkening pattern which can be converted into an ac signal by an IR detector.

If incident radiation containing many wavelengths is introduced into the system the output consists of a superposition of all the ac signals corresponding to all the wavelengths in the source.

The simplest method of converting the superposed frequencies, called the interferogram, back into the original spectrum is to play the tape recording through a wave analyzer. In this method, the paper feed of the chart recorder is mechanically linked to the frequency tuning control of the wave analyzer. This produces a spectrum chart having an abscissa scale which is linear with frequency (Fig. 1). Another method is to convert the interferogram to digital form permitting calculation of the inverse transform on a computer.

The large gain in sensitivity of the new method, compared with a conventional spectrometer method (Fig. 2), results from two factors: (1) The interferometer has a much larger entrance aperture, using a mirror rather than a narrow slit; and (2) the interferometer examines each wavelength throughout the period of each scan. The conventional spectrometer "sees" each frequency for only

MILITARY SYSTEMS DESIGN

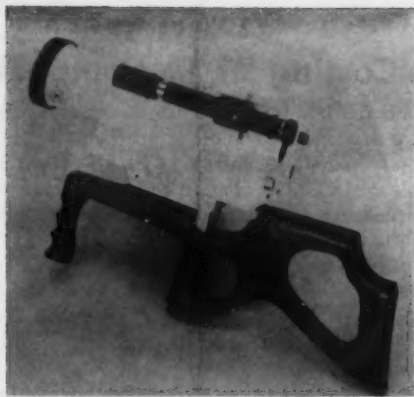


FIG. 2. HAND-HELD MODEL of Interferometer Spectrometer. This instrument, used to analyze infrared radiation from missile plumes at Cape Canaveral, continued to gather data after much larger conventional methods lost the missile.

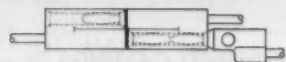
$1/n$ the scan time, if n is the number of resolution elements.

A number of military systems utilizing the interferometer are under development by Block Associates, Inc. In addition, a commercial version is now available with a choice of infrared detectors.

FOR MORE INFORMATION CIRCLE 228 ON READER-SERVICE CARD

New Patch-Cord Stacks or Extends

A new dual-purpose Model HB Extension/Stacking, Patch-Cord shields all hot leads when used as an extension cord with quick coupling to any banana-plug patch cord. It also allows vertical stacking at any banana jack for parallel or test connections (see figure).

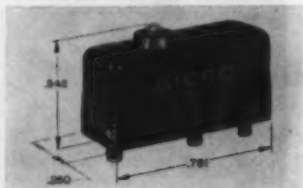


TEST and LOAD-CARRYING Model HB Patch-Cord quickly extends or parallels with shielded, secure coupling to any standard banana plug or jack.

The banana plugs are one-piece heat-treated beryllium copper spring. Contact resistance is less than 0.0001 ohm per plug in standard 0.166" dia banana jacks. 15 amperes continuous current capacity, insulated for 7500 WVDC, breakdown at 15 KV, the solder-bonded connection withstands pull test over 50 lbs. The Model HB Patch Cord is a product of the Pomona Electronics Co., 1500 East Ninth St., Pomona, Calif.

FOR MORE INFORMATION CIRCLE 229 ON READER-SERVICE CARD

SENSITIVE SWITCH



New subminiature switch holding differential travel to 0.001" max operates on $3\frac{1}{2}$ oz with release force 1 oz max. Electrical rating is 30 v with 3 amps inductive, 5 amp resistive and 24 amp max inrush.—Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

CIRCLE 230 ON READER-SERVICE CARD

MINI SERVO PACKS



Three miniature gear train servo packages accommodate ratios of 1000:1 from the motor to first synchro, and up to 36:1 from first to second synchro. Fine precision gears are used, entire package weights only 6 to 10 oz.—Clifton Precision Products Co., Inc., 5050 State Road, Drexel Hill, Pa.

CIRCLE 231 ON READER-SERVICE CARD

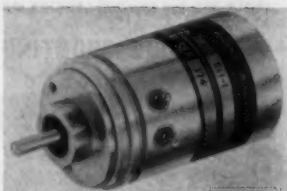
MYLAR-EPOXY CAPACITORS



High capacity in ultra-thin shapes for transistor and Printed Circuits is featured in new MCA series (shown actual size) available in 0.01 to 0.33 μ f. Bulletin MCA available—Hopkins Engineering Co., 12900 Foothill Blvd., San Fernando, Calif.

CIRCLE 232 ON READER-SERVICE CARD

MAGNETIC CLUTCH & BRAKES



New size 11 magnetic clutches and brakes with output torque of 80 oz-in minimum feature only 3 watt power consumption at 24 vdc, max engagement time of 15 msec.—Guidance Controls Corp., 110 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE 233 ON READER-SERVICE CARD

split second timing

in Your
Aero-Space
Circuits

demands EAGLE Mil-Spec MOTOR DRIVEN TIMERS



"AR" SERIES RESET TIMER
Following predetermined time cycle, motor stops. When clutch is released, timer resets to starting position within 150 milliseconds.



"AP" SERIES PROGRAM TIMER
Unit repeats predetermined cycle continuously until power to the motor is interrupted.

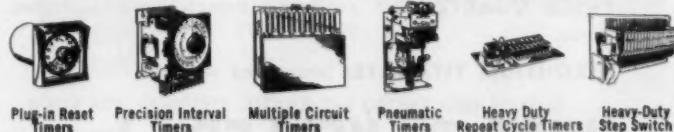
Here's a PERFECT PAIR of miniature, hermetically sealed motor driven timers for both airborne and ground support applications. Operative in 12 G acceleration, these versatile units perform reliably in extremes of vibration and temperature.

SPECIFICATIONS

• COMPACT— $2\frac{1}{4} \times 4\frac{1}{2}$ " outside cylinder dimensions • LIGHT WEIGHT—30 oz. or less • UP TO 7 independent load circuits • TIME CYCLES—1 second to several hours • POWER INPUT—Choice of 115 V., 60 cycle; 115 V., 400 cycle; 28 V.D.C. • FLEXIBLE—Can be equipped with plug-in header for quick change of time cycles

Write for Bulletins 825 and 830 or call your local Eagle Representative. He's listed in Sweet's Product Design File, Section 7d, or in Thomas Register.

TIMERS ALSO CUSTOM-BUILT TO MIL-SPECS. COMPLETE FACILITIES FOR QUALIFICATION TESTING.



MANUFACTURERS OF THE MOST COMPLETE LINE OF GROUND SUPPORT TIME CONTROLS.

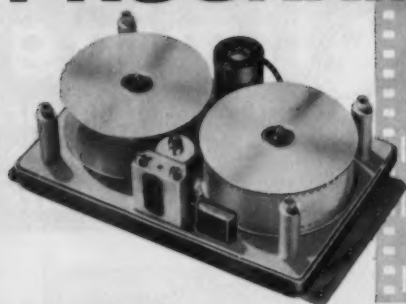


EAGLE SIGNAL COMPANY • Moline, Illinois
INDUSTRIAL DIVISION

DIVISION OF THE GAWWELL COMPANY, AN E. W. BLISS COMPANY SUBSIDIARY

CIRCLE 79 ON READER-SERVICE CARD

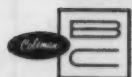
Proved, Accurate, Reliable PROGRAMMING



- Missile Guidance
- Ground Check-out
- Jet Engine Testing
- Industrial

13 CHANNELS — 4 HOUR PROGRAM

Where precise timing, maximum flexibility, minimum size and weight are needed in a programmer that has proved itself in numerous field applications, Beattie-Coleman MLPR13 meets all requirements. Controls programs up to 4 hrs., 42 min. duration on 13 channels. Programs quickly changed by inserting new punched 35mm Mylar tape. Reliability: 99.999%. Specified by Aerojet, Bendix, Convair, Douglas, Lockheed, Martin, North American, RCA, Ryan, Sandia and others. Send for catalog on this and other models to fit your needs.



BEATTIE-COLEMAN, INC.

1116 N. Olive St., Anaheim, Calif. • PR 4-4503

BRANCHES: 437 5th Ave., N.Y. • OR 9-5955 / 5831 Tomberg, Dayton, Ohio • BE 3-1916

CIRCLE 80 ON READER-SERVICE CARD

Let our 107 years of experience
making sapphire parts,
aid you in your problems!

Sapphire for Infra-Red

WINDOWS: round or square. Suitable for detector windows, substrates for reticles and filters, fluid cells, general systems.

LENSES, DOMES: concave or plano-convex. Suitable for detector cells, viewing domes.

FUSED QUARTZ: Flat windows, detector cell substrates, lenses.

STRONTIUM TITANATE: lenses and windows.

HUGO P. KELLER, Jr.

50 East 42nd Street, New York 17, N. Y.
Phone MUrray Hill 2-8450

CIRCLE 81 ON READER-SERVICE CARD

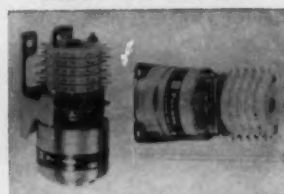
SIZE 5 SERVO MOTOR



New Type J126-06 miniature servo motor $\frac{1}{2}$ " dia x 0.968" long is designed for driving from transistorized amplifiers such as Kearfott A3105-02, gives instant response, 0.12 oz-in stall torque.—Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N. J.

CIRCLE 234 ON READER-SERVICE CARD

SELECTOR SWITCH



New solenoid-driven rotary selector switch using CTS Corp., wafer switches coupled to a PACSOL® rotary solenoid steps 360° in 30° increments and is single-pulse operated.—Licon Div., Illinois Tool Works, 6606 West Dakin St., Chicago, Ill.

CIRCLE 235 ON READER-SERVICE CARD

HIGH TEMP HARNESSING



New all stainless steel cushion clamps withstand temperatures as high as 1500°F. Are available in size range from $\frac{1}{4}$ " to 4" I.D. and are interchangeable with any standard $\frac{1}{4}$ " AN, MS or commercial-type cushioned loop clamps.—TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

CIRCLE 236 ON READER-SERVICE CARD

WAVEGUIDE SHORTING SWITCHES



New series of waveguide shorting switches covering range of 2.6 to 40 kmc provide VSWR 1.02 max in open position, 125 min in closed position.—Waveline, Inc., Caldwell, N. J.

CIRCLE 237 ON READER-SERVICE CARD

Casting of IR Components

INFRARED wavelengths extending from 3 microns to approximately 15 microns are being exploited in "second generation" infrared systems. These systems are planned to either augment radar systems or to be the primary detection system in situations where infrared is clearly the method of choice.

Breakthroughs have been made in two major areas to give the intermediate IR spectrum added importance in quantity production of military systems. The first was the development of an efficient detector to operate in this region. This problem is now considered solved. Among the cells now on the market are the lead selenide cells, developed and manufactured by the Hughes



FIG. 1. UNFINISHED CASTINGS of world's largest silicon dome—15" diameter—is held by two Hughes scientists. Casting method is significant in saving of time on material over machining of grown crystals.

Santa Barbara Research Center. These cells, with their associated cooling apparatus, are capable of withstanding the outer space and re-entry environments to which missiles and satellites are exposed.

The second major contribution is in the development of materials for transmitting, imaging and correcting radiant energy in this part of the spectrum.

Many natural salts with excellent IR transmission properties have been used for years in laboratory instruments. Unfortunately these are all hygroscopic and are otherwise unsuited to the environmental rigors which must be withstood by military systems. In about 1950, research reports from Purdue and other centers indicated single crystals of silicon and germanium also exhibited good optical properties in the IR spectrum. These materials are non-hygroscopic and mechanically strong. The technique of growing large single crystals

MILITARY SYSTEMS DESIGN

Speeds Production

was mastered in time, but the production of optical shapes from such crystals was slow and very expensive.

In 1958, the Hughes Aircraft Company reported that polycrystalline silicon had the same transmission properties as a single crystal, and that they had developed a process capable of casting these shapes directly rather than laboriously hogging them out of grown crystals. The savings in material and processing costs proved to be significant, while the physical and optical transmission characteristics of cast shapes are essentially the same as those from single crystals. (Fig. 1).

Major advantages of cast ultra pure germanium and silicon include:

Economical production of domes, lenses, windows and prisms which are rough cast to approximately finished dimensions. This greatly reduces fabrication cost and material loss. Hughes has cast the largest germanium infrared window (over 15" diameter) and the largest silicon lens (12" dia. See Fig. 2). There is no practical limitation to size or shapes.

The Hughes silicon and germanium infrared components (Fig. 2) can be coated for maximum transmission at a specific point within the 3-15 μ range, and minimum transmissions of 90% are practicable. Either in coated or uncoated state, polycrystalline silicon and germanium optics display excellent strength, durability and weathering characteristics.



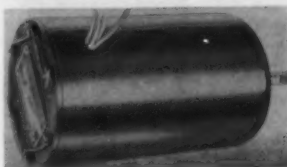
FIG. 2. INFRARED SHAPES; domes, lenses, windows and prisms can be efficiently cast from polycrystalline silicon and germanium.

Although they do have transmission limitations in high temperature operations, they show no reduction in transmission efficiency after passing through a high-temperature cycle nor are they physically affected by high temperature.

Military applications of infrared components include: Missile-seeking and homing systems, fire control, bomber defense, Airborne Early Warning systems, ballistic missile defense, IR viewing, reconnaissance, communication, range instrumentation and photography. Research and industrial applications additionally include: Tracking, weather forecasting, space IR observation, horizon sensors, IR spectroscopy, IR absorption analyzers, hydrometers, pyrometers, fire detection, hot-box detection, thermal imaging, medical diagnosis, proximity warning, communications and navigation.

FOR MORE INFORMATION CIRCLE 238 ON READER-SERVICE CARD

AXIAL BLOWER MOTOR



New Model DE-30-1 200 v 400 cps motor designed to drive an axial vane blower in altitudes to 30,000 ft is insulated with Class H insulation for operation in ambients to 180°C. Qualifies under MIL-M-7969 and MIL-E-5272.—Kearfott Div., General Precision Inc., McBride Ave., Little Falls, N. J.

CIRCLE 239 ON READER-SERVICE CARD

FREQUENCY DIVIDER/CLOCK



New Model 113AR Frequency Divider and Clock permits adjustment of frequency or time standards for greater absolute accuracy, simplifies obtaining detailed records of drift rates or time or frequency differences between oscillators in widely separated systems. Propagation path errors can be averaged out; Doppler errors virtually eliminated; 10- μ sec time comparison capability.—Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.

CIRCLE 240 ON READER-SERVICE CARD

CLOSED CIRCUIT TV



New MTI Orth 1 closed-circuit television, consisting of Image Orthicon Camera, Camera Control, and Monitor provides a low-cost, lightweight, portable equipment for training or observation in many applications, including underwater work, dark area surveillance and inspection of automatic processes. Using both transistors and tubes, the Orth 1 system provides useable pictures in light down to 0.0001 ft candle intensity. System features extreme operational simplicity.—Maryland Telecommunications, Inc., 10 Winters Lane, Baltimore 28, Md.

CIRCLE 241 ON READER-SERVICE CARD

EVEN FOR DEWPOINTS BELOW -100° F...



...YOU CAN RELY ON

TRINITY

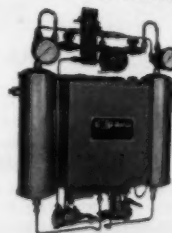
Super-Dry

AIR SYSTEMS

Extreme reliability that complex military systems must have, has been engineered into TRINITY's rugged Unitized Dry Air Systems. The hundreds of systems now in service prove it. Applications include pressurizing wave guides, coax & heliax cable; purging communications and fuel lines. That's why the special knowledge of TRINITY Engineers has been called on to produce low dewpoint air systems for missiles and other military programs.

Only Unitized Dry Air Systems are available with TRINITY's proven Heat-Les Dryers to assure continuous, economical dry air supply. Completely self-contained, ready-to-operate systems, including compressor, dryer, accumulator, instrumentation and necessary manifolding, are available in all capacity ranges.

...AND **TRINITY Heat-Les DRYERS**



Dynamic desiccant dryers providing dewpoints below -100°F. No bothersome, expensive heaters. Completely automatic. Available in a wide range of capacities. Install with compressor, or air supply of your choice.

WRITE FOR COMPLETE DETAILS ON DRYERS AND SYSTEMS...

TRINITY

World leader in dry gas/air systems

Heat-Les Dryers • Heat-reactivated Dryers
Thermocouples and Thermowells

TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

CIRCLE 82 ON READER-SERVICE CARD

LAPPED RUBY LASERS IN STOCK!!

IN STOCK FOR IMMEDIATE DELIVERY

1/4" x 1 1/2" • 1/4" x 2" • .200" x 2" • 1/4" x 2 1/2" • 1/4" x 3"

Flatness 1/4 wave or better. Parallelism 6 second of arc. All material very slow grown with "C" Axis Parallel to cylinder axis within 1 degree. Doping is .04% chrome by weight. Also 9 other dopings available immediately for special requirements—write or call:

DEter 1-3717

ADOLF MELLER COMPANY

BOX 6001 • PROVIDENCE 4, R. I.

CIRCLE 83 ON READER-SERVICE CARD

DC SOLENOID



New Model 12SD585 two-coil dc solenoid meeting 2-million test cycles of operation has 12 msec response time with 1 lb force at 0.125" stroke on 60 v dc. Temperature rise is held to 40°F max.—IMC Magnetics Corp., 6058 Walker Ave., Maywood, Calif.

CIRCLE 242 ON READER-SERVICE CARD

FINE RESOLUTION POTS



Where small increments of shaft rotation must produce proportionally small changes in resistance, new deposited film pots provide resolutions better than 0.01%, while meeting high ambient temperatures, severe vibration and shock conditions.—Mechatrol, a Div. of Servomechanisms/Inc., 1200 Prospect Ave., Westbury, L. I., N. Y.

CIRCLE 243 ON READER-SERVICE CARD

LIQUID SPRING



New Model 409.8 SS Liquid Spring Shok weighing only 1-oz absorbs 175 in-lbs energy in 1/10" stroke on new airborne radar where weight is worth \$1000/oz. Described in Handbook CH 1.—Taylor Devices, Inc., 200 Michigan Ave., No. Tonawanda, N. Y.

CIRCLE 244 ON READER-SERVICE CARD

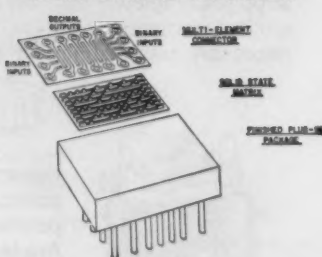
MICRO-MODULE CIRCUITS



New 789 Series encapsulated transistorized digital and logic circuit modules using reliability-proved components include binary counters, triggers, multivibrators, gates, inverters and flip-flops, operating to frequencies over 10 mc and with logic levels of 0v and +6v.—Walkirt Company, 141 W. Hazel St., Inglewood, Calif.

CIRCLE 245 ON READER-SERVICE CARD

SOLID-STATE MODULES



New built-in-place BIPCO® Modular Devices in modular form, said to cost a fraction of conventional circuit techniques, perform functions normally requiring many elements. First module available is a Binary Coded Decimal-to-Decimal Converter using the 4-2-2-1 code. Uses silicon diodes and drives a NIXIE indicator tube directly from inputs encoded in the binary coded decimal form.—Burrroughs Corp., Electronic Tube Div., Box 1226, Plainfield, N. J.

CIRCLE 246 ON READER-SERVICE CARD

TWIN CABINET FAN



New Twinpax cabinet flushing fan uses two Rotron Saucer fans to provide 400 cfm at 0.1" wg static pressure. Washable impingement type filter can be removed from front of cabinet. MIL-E-5272 and MIL-STD-202 requirements are met.—Rotron Manufacturing Co., Inc., Woodstock, N. Y.

CIRCLE 247 ON READER-SERVICE CARD

SHIELDED INDUCTORS



New Series 1500 slug-tuned shielded RF inductors cover range from 100 μh to 7.5 mh in nine steps, with average Q of 60 in the 0.1 to 1.0 mc spectrum.—North Hills Electronics, Inc., Glen Cove, L. I., N. Y.

CIRCLE 248 ON READER-SERVICE CARD

PARAMETRIC AMPLIFIERS



New boardband, MIL-Spec parametric amplifiers in L, S, C and X bands are now available from TI. S-band model giving bandwidths up to 75 mc at 15 db gain is shown. Noise figure, including circulator loss, is 3 db over the frequency range of 2.8 to 2.96 Gc. Amplifier uses XD-500 series gallium arsenide varactor diodes.—Texas Instruments Apparatus Div., P. O. Box 7045, Dallas 9, Texas.

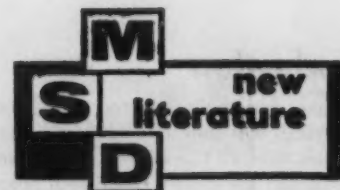
CIRCLE 249 ON READER-SERVICE CARD

WIREWOUND RESISTOR



New high-stability wire-wound resistor for digital computer and related applications holds drift within 0.003% over a 3-year period by relief of wire tension during fabrication and improved aging techniques.—Reon Resistor Corp., 155 Saw Mill River Rd., Yonkers, N. Y.

CIRCLE 250 ON READER-SERVICE CARD



SILICON DIODES in new medium power types are listed in three data sheets.—Controls Co. of America, Electron Division, Tempe, Ariz.

CIRCLE 251 ON READER-SERVICE CARD

HEAT RADIATORS for diodes/transistors are described in new 16-page catalog 1-HR with TO cases-outlined and cross-referenced to Bircher part numbers.—Chas. F. Booher, The Bircher Corporation, Monterey Park, Calif.

CIRCLE 252 ON READER-SERVICE CARD

SILICON RECTIFIERS in new miniature "TRIMLINE" series diffused junction types replacing large "top hat" types are described in series of 12 two-page bulletins.—Slaters Electric Inc., 45 Sea Cliff Ave., Glen Cove, N. Y.

CIRCLE 253 ON READER-SERVICE CARD

SILICON RECTIFIER specifications for double-diffused silicon diodes and stacks are given in new 5-page bulletin 300.—Semiconductor Div., Syntro Company, Homer City, Penna.

CIRCLE 254 ON READER-SERVICE CARD

BINISTOR, new 4-layer semiconductor device, is described with application circuits in new 8-page technical bulletin, AN-1360A.—Transitron Electronic Corp., Wakefield, Mass.

CIRCLE 255 ON READER-SERVICE CARD

COMPUTER-PREDICTED Reliability Data Card, as furnished with Princeton Diodes is described in 4-page brochure, with typical data cards.—Princeton Electronics Co., P. O. Box 127, Princeton, N. J.

CIRCLE 256 ON READER-SERVICE CARD

MODULE TEST fixture for heat transfer measurement on solid state components is described together with other products in new 4-page technical bulletin.—Special Products Dept., Melpar, Inc., 3000 Arlington Blvd., Falls Church, Va.

CIRCLE 257 ON READER-SERVICE CARD

GERMANIUM DIODES in stock are listed with characteristics and prices in new 2-page bulletin 164.—Ohmite Manufacturing Co., 3501 Howard St., Skokie, Ill.

CIRCLE 258 ON READER-SERVICE CARD

TRANSISTOR GUIDE for Communications Circuit designers, new 20 page Application Lab Report No. 701, gives basic rules for transistorized equipment design.—Lansdale Div. of Philco Corp., Church Road, Lansdale, Pa.

CIRCLE 259 ON READER-SERVICE CARD

RELIABILITY TEST results on Delco JAN 2N665 Transistors are given in new 22-page "Delco High Reliability" study.—Delco Radio Division, General Motors Corp., Kokomo, Ind.

CIRCLE 260 ON READER-SERVICE CARD

SILICON MESA Transistors, new types 2N497/A, 2N498/A, 2N656/A and 2N657/A for Military and Industrial service are described with characteristic curves in new 6-page brochure ECG-538.—Semiconductor Products Dept., General Electric Co., Kelley Bldg., Liverpool, N. Y.

CIRCLE 261 ON READER-SERVICE CARD

SILICON DIODE and Transistor circuits are given in 36-page pocket index booklet of Fairchild technical publications.—Fairchild Semiconductor Corp., 545 Whisman Rd., Mountain View, Calif.

CIRCLE 262 ON READER-SERVICE CARD

CATHODE SUBMINIATURE electron tube types are described with characteristics in new 12-page handbook.—Wm. Weed, Raytheon Co., Industrial Components Div., 55 Chapel St., Newton 58, Mass.

CIRCLE 263 ON READER-SERVICE CARD

TUBES for Low-Power industrial military and communications applications are described in 8-page handbook.—William Weed, Raytheon Company, Industrial Components Div., 55 Chapel St., Newton 58, Mass.

CIRCLE 264 ON READER-SERVICE CARD

ELECTRON TUBES in high power and industrial types are described in new 32-page condensed data booklet.—R. A. Mannes, The Machlett Labs., Inc., Springdale, Conn.

CIRCLE 265 ON READER-SERVICE CARD

AMPLIFIER-MODULE consisting of 20 single-stage transistor amplifiers for general switch amplifications on printed circuit card is described in 2-page data sheet CM-114.—Datex Corporation, 1307 S. Myrtle Ave., Monrovia, Calif.

CIRCLE 266 ON READER-SERVICE CARD

CROSSBAR Switching patterns are described in new 20-page technical bulletin, "High Performance Crossbars."—James Cunningham, Son & Co., 33 Litchfield St., Rochester, N. Y.

CIRCLE 267 ON READER-SERVICE CARD

THERMAL SWITCH for high temperature, hermetically sealed, can be field adjusted and calibrated from -20° to 1750°F .—Control Products, 280 Ridgedale Ave., East Hanover, N. J.

CIRCLE 268 ON READER-SERVICE CARD

RATE GYRO Nomograph makes possible rapid determination in $^{\circ}/\text{sec}$ and acceleration when frequency and displacement are known.—Micro Gee Products, Inc., Dept. NOM, P. O. Box 1005, Culver City, Calif.

CIRCLE 269 ON READER-SERVICE CARD

SYNCHROS and Resolvers, over 200 models, are listed in 6-page quick reference catalog, grouped by size and winding compensation.—American Electronics, Inc., Instrument Div., 9503 West Jefferson Blvd., Culver City, Calif.

CIRCLE 270 ON READER-SERVICE CARD

SYNCHRO selection data for Size 23, 60 cps Thru-Bore Synchros are listed in 2-page data sheet.—Vernitron Corp., 125 Old Country Road, Carle Place, L. I., N. Y.

CIRCLE 271 ON READER-SERVICE CARD

SERVO Motor Control by Sciakydyne Zero-Error system is described in 4-page bulletin #343.—Sciaky Bros., Inc., 4915 W. 67th St., Chicago 38, Ill.

CIRCLE 272 ON READER-SERVICE CARD

SYSTEM ERROR Bridge, for testing systems containing synchros and resolvers is described in new 12-page bulletin.—Theta Instrument Corp., Saddle Brook, N. J.

CIRCLE 273 ON READER-SERVICE CARD

GEARS in Spiral Bevel and Hypoid Standard designs are specified in new 6-page catalog.—Perkins Machine & Gear Co., West Springfield, Mass.

CIRCLE 274 ON READER-SERVICE CARD

FLEXIBLE COUPLINGS in $\frac{1}{2}$ " to $1\frac{1}{2}$ " O. D. sizes are described with torsional and lateral deflection curves in new 4-page catalog No. 40.—Naugler Engineering, Inc.

CIRCLE 275 ON READER-SERVICE CARD

DIFFERENTIAL PHASE SHIFTER for synchro system measurements providing constant output voltage continuously variable in phase from 0° to 360° is described in 2-page data sheet C03721018.—Kearfott Div., General Precision, Inc., Little Falls, N. J.

CIRCLE 276 ON READER-SERVICE CARD

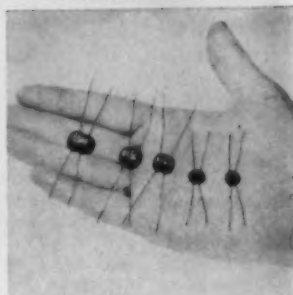
LOX-SAFE GAUGES. Ashcroft Maxisafe Duragauges and pneumatic transmitters for liquid oxygen service manufactured strictly free from hydrocarbons, foreign particles and other contaminants, are described in new 4-page Bulletin 370.—Manning, Maxwell & Moore, Inc., Stratford, Conn.

CIRCLE 277 ON READER-SERVICE CARD

LOW NOISE AMPLIFIER, self-contained transistorized unit for extending sensitivity limits of laboratory instruments is described in 2-page brochure, "Model 203 High-Gain, Low Noise Miniature AC Amplifier," Quantech Laboratories, Inc., Boonton, N. J.

CIRCLE 278 ON READER-SERVICE CARD

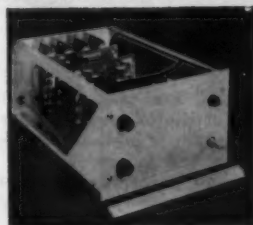
PREDICTABLE PULSE TRANSFORMERS



New DATAPULSE transformers, designed to precise specifications, can be fitted to user's circuit requirements plotted on graphs and charts supplied by PCA. Information catalog available.—PCA Electronics, Inc., 16799 Schoenborn St., Sepulveda, Calif.

CIRCLE 279 ON READER-SERVICE CARD

ANTENNA MULTICOUPLER



New Model 7 Multicoupler, permitting simultaneous use of eight receivers from a single antenna in the 2 mc to 32 mc band, is completely transistorized, using only 30 watts input power. Input and output impedances are matched at 72 ohms for use with HF direction finding or communications systems.—Trak Electronics Company, Inc., Wilton, Conn.

CIRCLE 280 ON READER-SERVICE CARD

WAVEGUIDE "Y" CIRCULATORS



Improved Hughes 20-20 circulators with more than 20 db isolation are now available to operate within 20% of specified center frequency anywhere within the 2.6 to 12.4 mc range.—Hughes Aircraft Co., Culver City, Calif.

CIRCLE 281 ON READER-SERVICE CARD

NEW
The
"G FRAME"
series

Typical curve on a
"G FRAME" series
2 pole 3 ϕ motor

SPECIFICATIONS:

Dia.: 3 $\frac{1}{2}$ " (plain)
3 $\frac{1}{2}$ " (finned)

H.P.: 1/400 to 1/4

Freq.: 60 cps

Phase: 1 ϕ or 3 ϕ

Poles: 2 or 4

Ambient Temp.:
-55 $^{\circ}\text{C}$ to +125 $^{\circ}\text{C}$

Designed to military and industrial specifications the new "G FRAME" series motors are another addition to the wide line of AIR MARINE motors, blowers and fans.

A symbol of quality products... This trademark identifies the Air Marine line of carefully engineered products designed for military and industrial applications.

air marine motors, inc.
amityville, new york
los angeles, calif.



CIRCLE 84 ON READER-SERVICE CARD



FROM

Metron

A PART OR A PACKAGE

A PART: Miniature fixed ratio speed changers

RATIOS: 448 ratios from 1:1 to 531441:1
HORSEPOWER: .025 maximum
TORQUE: 24 oz-in maximum
SPEED: 10,000 RPM maximum
BACKLASH: Less than 15', on anti-backlash Series 9
WEIGHT: 3 to 6 oz depending on ratio
BEARINGS: double, heavy-duty ball
MOUNTINGS: available with versatile foot mounts
DELIVERY: 10 days

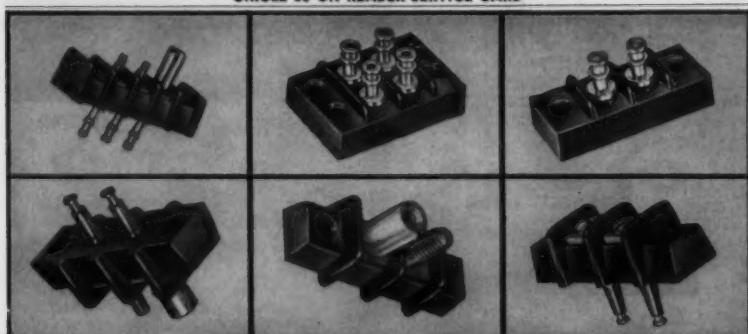
A PACKAGE: Call on Metron for help with your speed changing design problems. Tell us what *results* you are after; we'll call on 18 years' experience in making miniature speed changers and precision instruments to come up with the right package for you. Send your prints today—or, better yet, call us *now*!



METRON INSTRUMENT CO.

432 Lincoln, Denver 3, Colo., PE 3-3764, TWX: DN 194

CIRCLE 85 ON READER-SERVICE CARD



Kulka

STUD AND TURRET TERMINAL BLOCKS

FOR WIRING CONVENIENCE

For faster, better, and more appropriate terminations, Kulka offers all their popular terminal blocks with your choice of terminal. Now you can choose from regular screw-type, solder-turret, feed-through, threaded stud, or any combination of terminals to best suit your specific requirements. And, you can call your own choice of finishes—electro-tinned, silver-plated, or even gold-plated over silver. Kulka maintains complete design and consultation services to aid customers in the proper terminal selection. Send us your requirements, or...

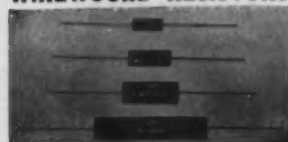
WRITE FOR
COMPLETE
DETAILS

KULKA ELECTRIC CORP.

633-643 SO. FULTON AVENUE, MOUNT VERNON, N. Y.

CIRCLE 86 ON READER-SERVICE CARD

WIREWOUND RESISTORS



New vitreous-enamelled axial-lead wirewound resistors in 3, 5 and 10-watt sizes have been revised to follow the resistance-value progressions shown in MIL-STD-90178B, corresponding to Styles RW57, RW58 and RW59 of MIL-R-25C.—Ohmite Manufacturing Company, 3649 Howard St., Skokie, Ill.

CIRCLE 282 ON READER-SERVICE CARD

HIGH/LOW MU TUBE



New 6EA7 dual triode for vertical-deflection oscillator and amplifier applications has a high-mu triode as section one and a low-mu, high-perveance triode for section two.—General Electric Company, Receiving Tube Dept., Owensboro, Ky.

CIRCLE 283 ON READER-SERVICE CARD

CONTROLLED RECTIFIERS



New Series 2N1881-2N1885 controlled rectifiers providing cutoff current and gate-firing sensitivity improvement by a factor of 5 over 2N1595 series are available in TO-9 outline with all leads isolated.—Solid State Products, Inc., 1 Pingree St., Salem, Mass.

CIRCLE 284 ON READER-SERVICE CARD

RF CHOKES



New 2953 series of coil-wound chokes provide four fixed inductance values from 0.5 to 5.0 mh for both commercial and Military applications.—Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 285 ON READER-SERVICE CARD

SERVO MICROMODULATOR (Solid-state magnetic) for low level ac and dc instrumentation is described in new 4-page catalog.—James Electronics Inc., 4050 No. Rockwell St., Chicago 18, Ill.

CIRCLE 286 ON READER-SERVICE CARD

IRON POWDER magnetic clutches and brakes in sizes 18, 15, 11 and 9 are described in two new 2-page engineering bulletins.—Hodge Controls, P. O. Box 1156, Greenwich, Conn.

CIRCLE 287 ON READER-SERVICE CARD

SERVO MOTORS, size 24, with and without gear trains, are described in new 4-page bulletin MO-3.7A.—Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., 125 Amory St., Boston 19, Mass.

CIRCLE 288 ON READER-SERVICE CARD

MINIATURE DIFFERENTIAL, Ford 3/32" Standard, operating in working circle of 0.585" diameter and weighing less than 1/2 oz, is described in 4-page specification.—Ford Instrument Co., Div. of Sperry Rand Corp., 31-10 Thomson Ave., Long Island City 1, N. Y.

CIRCLE 289 ON READER-SERVICE CARD

MINI DC-AC High-voltage converters, dc-ac regulated inverters and highly regulated ac to dc power units are described in new 8-page Power Systems brochure.—Victory Electronics, Inc., 50 Bond St., Westbury, N. Y.

CIRCLE 290 ON READER-SERVICE CARD

DC POWER Supply using static-magnetic line voltage regulation with transistorized shunt load regulator is described in new 8-page brochure DCX-361A.—Sola Electric Co., Elk Grove Village, Ill.

CIRCLE 291 ON READER-SERVICE CARD

MAGNETIC TRIQGER units for firing SCR's (silicon controlled rectifiers) are described in new 4-page folder and specification sheets.—Ovitron Corporation, 37-05 48th Ave., Long Island City 1, N. Y.

CIRCLE 292 ON READER-SERVICE CARD

SILICON BRIDGE Rectifier, 140 v rms, 1.8 amp continuous, weighing only one oz and meeting MIL-E-5400 is described in 2-page F-161.—Ledex Inc., 123 Webster St., Dayton 2, Ohio.

CIRCLE 293 ON READER-SERVICE CARD

POWER SUPPLIES in modular and laboratory models are described with specifications in 4-page catalog.—Invar Electronics Corp., 323 West Washington Blvd., Pasadena, Calif.

CIRCLE 294 ON READER-SERVICE CARD

HEAVY DUTY, high-voltage power supplies for radar and laboratory work with TWT's and Klystrons are described in series of eight 1-page data sheets.—FXR, Inc., 25-26 50th St., Woodside 77, N. Y.

CIRCLE 295 ON READER-SERVICE CARD

HV RECTIFIERS made up of silicon or selenium cells encased in insulated tubes are described for all ratings in two 2-page bulletins; SI-1000 for Silicon, SE-1000 for Selenium.—Electronic Devices, Inc., 50 Webster Ave., New Rochelle, N. Y.

CIRCLE 296 ON READER-SERVICE CARD

CAPACITORS in Film and Paper dielectric types are listed with specifications in new Capacitor Catalog.—Chicago Condenser Corp., 3255 West Armitage, Chicago 47, Ill.

CIRCLE 297 ON READER-SERVICE CARD

HV CAPACITORS, Type CL Plastic Film dc types, are described in Catalog 101 for the 2 to 20 kv range.—Corson Electric Mfg., Corp., 540 39th St., Union City, N. J.

CIRCLE 298 ON READER-SERVICE CARD

NON-POLAR TANTALUM capacitors in new ultraminia-ture size for use up to 50 v dc are described in 4-page Minitan bulletin.—Components, Inc., Smith Street, Biddeford, Me.

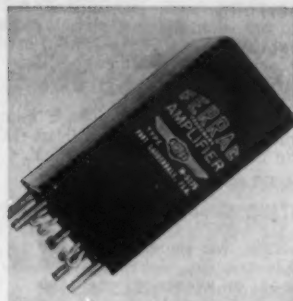
CIRCLE 299 ON READER-SERVICE CARD

NON-POLAR CAPACITORS, new Solid-Electrolyte Tantalum types are described with complete characteristics in 12-page engineering bulletin No. 3521.—Sprague Electric Co., North Adams, Mass.

CIRCLE 300 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

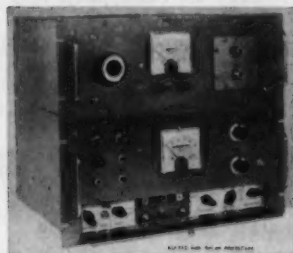
DC MAGNETIC AMPLIFIERS



New Type M-5175 dc magnetic amplifier delivers linear output voltage (min) ± 7.5 v dc into 1000-ohm load with signal levels in mv range. Power 115 v rms at 400 cps. Operating temp range -55° to $+85^{\circ}\text{C}$. Withstands 30-G shock, 10-G vibration.—*Airpax Electronics, Inc., Seminole Div., Fort Lauderdale, Fla.*

CIRCLE 301 ON READER-SERVICE CARD

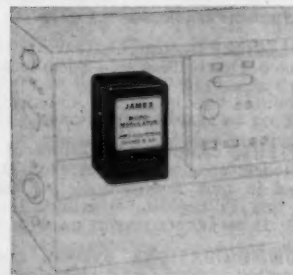
LOW NOISE AMPLIFIERS



New 5000 Series microwave amplifiers cover 500 mc to 18 kmc, include standard bands, provide 10 to 15 db noise figures with 25 db or more gain. Units consist of TW tube, power supply, and (where required) special focusing solenoid with power supply. Operation on input power from 50-450 cps permits use of non-standard and airborne supplies.—*Alfred Electronics, 897 Commercial St., Palo Alto, Calif.*

CIRCLE 302 ON READER-SERVICE CARD

SOLID STATE MODULATOR



New Micro-Modulator Model C-3001 provides equivalent of a chopper and a high quality input transformer in servo control applications where dc and ac must be modulated.—*James Electronics, Inc., 4050 N. Rockwell St., Chicago 18, Ill.*

CIRCLE 303 ON READER-SERVICE CARD

CIRCLE 87 ON READER-SERVICE CARD →

For

USAF MINUTEMAN:

a never-failing stream of chilled water for 3 years.

Assignment:

For Boeing Airplane Company—design and produce a highly reliable water chiller for constant temperature control of Minuteman's guidance and control section. **Achievement:** A water chiller designed and produced for an MTBF of 232,558 hrs.; failure rate $.430 \times 10^{-5}$. **Engineering Design**

Features: 1. Elimination of potential breakdown due to electrical contacts by utilizing a "solid state" activated modulating hot gas by-pass valve.

System operates continuously, decreasing failure rate inherent in start-stop operation. 2. Elimination of many moving parts. Example: Capillary tube replaces expansion valve. 3. Hermetic refrigeration system, elimination of rotating seal. Immediately operational, even after prolonged storage. 4. Temperature of supply water controlled to ± 0.2 F. (Exceeded specification requirement of ± 1.0 F.)

5. "Flooded chiller" assures minimum capacity variance in ambient range of 50 F to 110 F. 6. Adjustable temperature range of supply water from 36 F to 46 F. 7. Withstands

acoustical blast of 140 decibels. 8. Meets the following specifications: (1) Salt spray — MIL-E-4970; (2)

Shock and vibration (while operating)— ± 7.5 G,

.4" double amplitude, Range 5 to 12 cps.; (3) Radio

interference — (STL) GM07-59-2617A. 9. Main-

tenance requirements extremely low due to features

1 through 4. 10. Reduction of bulk through elimination

of moving parts and simplification of

design. Unit measures 17.75" x 20.75"

x 33.85" h. Highly transportable

and highly adaptable to various

installations where available

space is critical factor. 11. Ellis

and Watts performed all

tests and supplied detailed

reliability analysis

report with water

chiller units.



ELLIS AND WATTS PRODUCTS, INC.

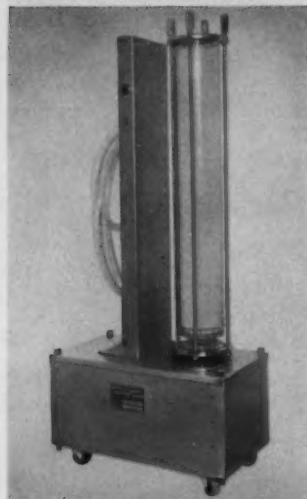
Creative Engineering in
Temperature and Humidity Control

• Air Conditioners • Liquid Coolers
• Dehumidifiers • Console Coolers
P.O. Box 33D, Cincinnati 36, Ohio

TECHNIC'S GOLD SAVERS



SAVES THE GOLD YOU NOW LOSE



These are the first commercial units developed for the recovery of gold heretofore lost through dragout rinsing

MODEL 'C' will reclaim gold from any cyanide or alkaline solution

MODEL 'A' is designed to save gold from any acid or neutral cyanide solution

SIMPLE TO OPERATE
A HIGHLY PROFITABLE INVESTMENT

Technic Inc



P.O. Box 965
Providence, R.I.

Plant: Cranston, R.I.
Stuart 1-6100

Chicago Office: 7001 No. Clark St.

CIRCLE 98 ON READER-SERVICE CARD

TRANSISTORIZED AMPLIFIERS



New light-weight audio and video amplifiers and logarithmic voltage attenuators are transistorized, battery-powered, cylindrical models easy to use in lab setups. High and low impedance amplifiers have 30 and 40 db gain respectively.—Kane Eng. Laboratories, 845 Commercial St., Palo Alto, Calif.

CIRCLE 304 ON READER-SERVICE CARD

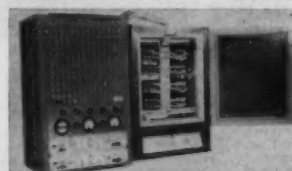
TIMING MODULES



New G-V Type 406 Microminiature Timing Modules can be used directly as solid-state time delay for intervals of 0.1 to 60 seconds or to operate a separate magnetic relay for greater load capacity.—G-V Controls, Inc., Okner Parkway, Livingston, N. J.

CIRCLE 305 ON READER-SERVICE CARD

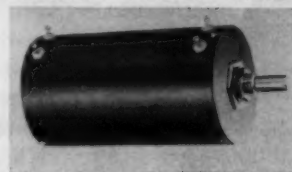
TRANSISTOR LIFE TESTER



New Tenco test system features individual collector current controls for up to 220 transistors undergoing oven life testing. Temperature of oven is controlled to $\pm 1^\circ\text{C}$ over 25° to 150°C range.—Tenco Electronics, Inc., 108 Cummington St., Boston 15, Mass.

CIRCLE 306 ON READER-SERVICE CARD

VARIABLE DELAY LINE



New Helidel® all-metal delay line Series 8810, provides delay times continuously variable from 0.1 μsec to 1 μsec with rise time less than 10% of total delay time.—Helipot Div., Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif.

CIRCLE 307 ON READER-SERVICE CARD

PULSE RATE INTEGRATOR



New Series PI-300 Pulse Rate Integrator furnishes low impedance dc voltage and current outputs proportional to frequency or pulse rate of input. Over 70 configurations of frequency, input and output characteristics. Operates from 5 cps to specified upper frequency for full-scale output, with adjustment to vary full-scale frequency over 2:1 range.—Anadex Instruments, Inc., 14734 Arminta St., Van Nuys, Calif.

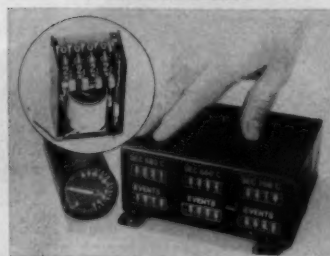
CIRCLE 308 ON READER-SERVICE CARD

TUNNEL & BACKWARD DIODES

New series 1 and 5 ma germanium tunnel diodes for high frequency performance have close peak current tolerance limits needed in computers. Also two complementary germanium backward diodes for use with tunnel diodes in logic circuits, etc., have application in low level rectifier and detector circuits. Leakage current is 400 mv; forward voltage is 15% of companion tunnel diode's peak current. Backward diodes have typical shunt capacitance of 3 μf , so that one tunnel diode can drive several with little reduction in speed.—Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.

CIRCLE 309 ON READER-SERVICE CARD

MINIATURE COUNTER DEVELOPMENT



New miniaturized multiple element counter meeting light weight and low power requirements under high shock and environmental conditions is typical of development capabilities of Durant engineers in counting and recorder applications.—Durant Manufacturing Co., 1981 No. Buffum St., Milwaukee 1, Wis.

CIRCLE 310 ON READER-SERVICE CARD

TUBULAR CAPACITORS using metallized mylar and providing .001 to 4 μf in miniature sizes are described in new 4-page catalog, Form 795.—The Potter Company, 1950 Sheridan Road, No. Chicago, Ill.

CIRCLE 311 ON READER-SERVICE CARD

TANTALUM FOIL Capacitors giving high capacity in miniature size are described in new bulletin GEA-7226.—General Electric Co., Schenectady 5, N. Y.

CIRCLE 312 ON READER-SERVICE CARD

PLASTIC-DIELECTRIC Capacitors are described in new 4-page bulletins: GEZ-3277, for MIL-C-27287, 50 to 600 v dc units; GEZ-3278, for general use, 100 to 600v dc units.—General Electric Co., Schenectady 5, N. Y.

CIRCLE 313 ON READER-SERVICE CARD

PRECISION POTS Shortform catalog lists specs on Squaretrim and latest standard rotary pots.—Potentiometer Div., Daystrom Inc., Archbald, Penna.

CIRCLE 314 ON READER-SERVICE CARD

SELF-BALANCING POTENTIOMETER accepting outputs from the thermocouples or other electrical transducers in flight instrumentation is described in new 4-page data sheet, "Autopot Self-Balancing Potentiometer."—Pacific Division, Daystrom, Inc., 9320 Lincoln Blvd., Los Angeles 45, Calif.

CIRCLE 315 ON READER-SERVICE CARD

PRECISION RESISTORS in all deposited carbon types are described in new 8-page catalog.—Pyrofilm Resistor Co., Inc., U. S. Highway 46, Parsippany, N. J.

CIRCLE 316 ON READER-SERVICE CARD

"L" & "Q" CURVES for eleven models of glass coil variable inductors covering 10-250 mc range are given in series of 2-page data sheets.—Corning Electronic Components, Bradford, Pa.

CIRCLE 317 ON READER-SERVICE CARD

TOROIDAL miniature transformers, inductors and magnetic amplifiers meeting MIL-Specs are described in latest 20-page catalog.—Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 318 ON READER-SERVICE CARD

PULSE TRANSFORMER parameters, equivalent circuits, inductance and resistance charts and physical characteristics are typical data contained in new 8-page Data-pulse Transformer Catalog.—PCA Electronics, Inc., 16799 Schoenborn St., Sepulveda, Calif.

CIRCLE 319 ON READER-SERVICE CARD

TRANSISTOR TRANSFORMERS in subminiature sizes to reduce size of equipment, match outputs and improve frequency response are listed in set of three transistorformers Data Sheets.—JB Electronic Transformers, Inc., 2308 West Armitage Ave., Chicago 47, Ill.

CIRCLE 320 ON READER-SERVICE CARD

PULSE TRANSFORMER Standard Test for Hamilton Pulse transformers is given in new 2-page data sheet 901.—Electronics Div., Hamilton Watch Co., Lancaster, Pa.

CIRCLE 321 ON READER-SERVICE CARD

WAVEGUIDES, FLEXIBLE rectangular, are specified in simplified reference chart TL-605.—Technicraft Div., Electronic Specialty Co., 116 Waterbury Road, Thomaston, Conn.

CIRCLE 322 ON READER-SERVICE CARD

FREQUENCY METERS, complete PRD line of coaxial and waveguide models covering ranges from 0.1 to 40 kmc are described in new 4-page bulletin 700.—PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N. Y.

CIRCLE 323 ON READER-SERVICE CARD

MICROWAVE COMMUNICATIONS System, complete flexible 6 kmc carrier equipment is described in new 12-page bulletin LMR-20.—Lynch Communication Systems, Inc., 695 Bryant, San Francisco 7, Calif.

CIRCLE 324 ON READER-SERVICE CARD

MICROWAVE RELAY Link consisting of self-contained transmitter and self-contained receiver operates in 10.5-13.2 kmc band with 0.1 watt power, 5 mc bandwidth data or TV & communications channels. 8-page bulletin describes.—GPL Div., General Precision, Inc., Pleasantville, N. Y.

CIRCLE 325 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

MICROWAVE precision wavemeters, mixers and filters in standard lines are listed with complete specifications in new 6-page brochure.—Frequency Standards, P. O. Box 504, Asbury Park, N. J.

CIRCLE 326 ON READER-SERVICE CARD

DETECTOR MOUNTS for crystals in coaxial and waveguide configurations, 50 mc to 40 kmc, are listed in new 4-page brochure. AEL, Inc., 121 N. 7th St., Philadelphia, Pa.

CIRCLE 327 ON READER-SERVICE CARD

WAVEGUIDE BEND ordering information and descriptions of standard "E" and "H" plane configurations are given in new 4-page bulletin.—Waveguide, Inc., 1769 Placentia Ave., Costa Mesa, Calif.

CIRCLE 328 ON READER-SERVICE CARD

CERAMIC MAGNET, F-620, with minimum coercive force of 3000 Oersteds for TWT and other applications is described in new 2-page Data sheet Form 106.—D. M. Steward Mfg. Co., Chattanooga, Tenn.

CIRCLE 329 ON READER-SERVICE CARD

IR FILTERS using Fabry-Perot interference techniques are described in new 4-page Technical Bulletin 6.—Infrared Industries, Inc., Waltham 54, Mass.

CIRCLE 330 ON READER-SERVICE CARD

LIGHTWEIGHT MIRRORS for airborne optical and other low-inertia mirror systems are described in new 2-page bulletin.—Mr. Morton Lipkins, Chief Engineer, Precision Lapping Co., Inc., 34 Clinton Ave., Valley Stream, L. I., N. Y.

CIRCLE 331 ON READER-SERVICE CARD

GRO SWEEP Synchronizing accessory which automatically locks sweep time to signal period is described in new 2-page data sheet.—Chadwick-Helmuth Company, 472 Duarte Road, Monrovia, Calif.

CIRCLE 332 ON READER-SERVICE CARD

TRACKING SYSTEMS for missiles and satellites and Antenna Pattern range instrumentations are described in new 20-page catalog.—Antlab, Inc., 6330 Proprietors Road, Worthington, Ohio.

CIRCLE 333 ON READER-SERVICE CARD

MAGNETIC Preamplifiers for low level and common mode isolation instrumentation are described in new 6-page Bulletin L-6.—Acromag, Incorporated, 22515 Telegraph Road, Southfield (Detroit), Mich.

CIRCLE 334 ON READER-SERVICE CARD

MECA (Maintainable Electronic Component Assemblies) are described in new 6-page brochure.—AMP Incorporated, Harrisburg, Pa.

CIRCLE 335 ON READER-SERVICE CARD

AUTOMATIC ANNOUNCING SYSTEM, 6-page Bulletin 3.8 describes system that creates voice announcements by combining pre-recorded segments automatically when appropriate numbers are dialed from central or remote locations.—Westrex Corp., Recording Equipment Dept., Div. Litton Industries, 6601 Romaine St., Hollywood 38, Calif.

CIRCLE 336 ON READER-SERVICE CARD

ENVIRONMENTAL, Flight, Propulsion, and Temperature controls with accessory components are described in 64-page 1961 catalog, "Controls for Flight".—Adv. Dept., United Control Corp., 4540 Union Bay Pl., Seattle 5, Wash.

CIRCLE 337 ON READER-SERVICE CARD

ELECTROSTATIC CHARGE amplifier for use with natural quartz accelerometers, is described in new 2-page data sheet.—Kistler Instrument Corp., 15 Webster St., North Tonawanda, N. Y.

CIRCLE 338 ON READER-SERVICE CARD

NUCLEAR INSTRUMENTS, Systems and Components are described for complete Hamner line in new 39-page catalog.—Hamner Electronics Co., Inc., P. O. Box 531, Princeton, N. J.


CIRCLE 339 ON READER-SERVICE CARD

NETWORK WORK FORM assists designers in specifying resistor networks by defining mechanical and electrical parameters. Provides reference data and purchase or production order data. Copy on request. General Resistance, Inc., 430 Southern Blvd., New York 55, N. Y.

CIRCLE 340 ON READER-SERVICE CARD

SUPERIOR IN EVERY DETAIL



THIS IS  Type 3000/3001 Cable Plug and Jack

Different? Yes. And better, too. "ConheX" sub-miniature r.f. connectors are now in use in the most critical electronic assemblies, and specified by the most discriminating manufacturers of equipment. The many obvious advantages of the "ConheX" design result in easier assembly, greater dependability, and better electrical characteristics. Now "ConheX" is available in two basic styles—Clamp-On for limited runs and easy field replacement, and Crimp-On, designed to save time and money in large production runs. Write for Complete catalog...



Sealectro and only Sealectro

MAKES "CONHEX" SUB-MINIATURE RF CONNECTORS

SEALECTRO CORPORATION, 139 HOYT STREET, MAMARONECK, N. Y.
British Branch: Sealectro Corporation, Hershaw Factory Estate, Lyon Road, Walton-on-Thames, Surrey, England.

CIRCLE 89 ON READER-SERVICE CARD

IDL "STANDARD" TELEMETERING COMMUTATORS

satisfy 98% of
PAM and PDM
System Requirements

Within this case, IDL provides sampling rates, channel density, low noise level operations and motor characteristics specified by IRIG requirements in telemetering systems. The combinations offered by our production plan are so numerous that most telemetering requirements can be met.

IDL "Standard" Telemetering Commutators offer these advantages to the systems design engineer:

- Missile reliability
- Long, service-free unattended life
- Uniform quality and workmanship
- Uniform installation requirements
- Shorter delivery schedules
- Unlimited production capacity for follow-on
- Uniform pricing

For complete information, write for IDL Brochure No. G361 describing "Standard" High Speed Rotary Switches.



Case Style No. 1

INSTRUMENT DEVELOPMENT LABORATORIES, INC.

Subsidiary of Royal McBee Corporation

52 MECHANIC STREET, ATTLEBORO, MASS.

CIRCLE 90 ON READER-SERVICE CARD

ELECTROPLATED WIRES



For many years we have specialized in continuous electroplating of wires with emphasis on small sizes (as small as .00012"). By electroplating it is possible to combine the properties of metals having widely different characteristics. Example: a Gold plated Tungsten wire combines the extremely high tensile strength of Tungsten with the solderability of Gold. Many other combinations are possible to suit individual requirements.

Write for Latest Brochure

SIGMUND COHN MFG. CO., INC.

121 SOUTH COLUMBUS AVENUE, MOUNT VERNON, N.Y.

CIRCLE 91 ON READER-SERVICE CARD

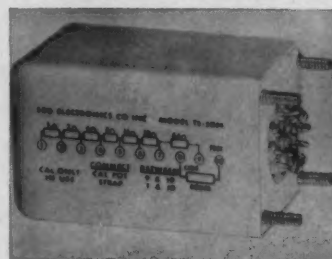
VARIABLE DELAY LINE



New variable lumped constant delay line, Model VLR15, features independent variability of all three taps. Each tap has resolution of 0.025 μ sec with delay variable from 0 to 1.5 μ sec and delay/rise-time ratios up to 21:1.—Allen Avionics, Inc., 255 East Second St., Mineola, L. I., N. Y.

CIRCLE 341 ON READER-SERVICE CARD

WIDE BAND FILTERS



New PPC series of delay-distortionless filters covering the entire range of data transmission and processing required in high-reliability missile programs, is designed to user's specifications.—SEG Electronics Co., Inc., 12 Hinsdale St., Brooklyn 7, N. Y.

CIRCLE 342 ON READER-SERVICE CARD

BI-STABLE MAGNETIC AMPLIFIER

New Lumen Model 1211 bi-stable magnetic amplifier, designed to operate on the output of photoresistor with a varying resistance of 2 to 5



megohms, provides an output of approximately 10 v 10 ma capable of driving a heavy-duty relay coil. Narrow band width ensures proper pick-up and drop-out with slow increases and decreases of the photo-resistance.—Lumen, Inc., P. O. Box 905, Joliet, Ill.

CIRCLE 343 ON READER-SERVICE CARD

BASIC ALLOY Melting Points of Aluminum, Gold, Indium and Silver alloyed with Boron, Gallium, Germanium, Antimony, Silicon, Tin, Silver, Aluminum, Lead, Cadmium, Phosphorous, Selenium, Tellurium, Magnesium, Arsenic, Nickel, Copper, and Indium are listed in four new data sheets.—Semi-Alloys, Inc., 550 South Fulton Ave., Mount Vernon, N. Y.

CIRCLE 344 ON READER-SERVICE CARD

GRAPHITE. Ultra Pure grade with maximum impurity contents down to orders of 10 parts per million, is described in new 4-page bulletin C-611.—Speer Carbon Company, St. Marys, Pa.

CIRCLE 345 ON READER-SERVICE CARD

SILICONE RUBBER insulated wire and cable for ship-board, missile and radiation-resistant applications are described in new 4-page bulletin.—Boston Insulated Wire & Cable Co., 63 Bay St., Boston 25, Mass.

CIRCLE 346 ON READER-SERVICE CARD

TERMINAL Specifications for use with Bu-Ships Terminal Boards are contained in 2-page catalog sheet.—AMP Incorporated, Harrisburg, Pa.

CIRCLE 347 ON READER-SERVICE CARD

HIGH VOLTAGE connectors and receptacles in miniature size for low current use at 16-25 kv are described in new data sheet.—American Research and Manufacturing Corp., 920 Halpine Ave., Rockville, Md.

CIRCLE 348 ON READER-SERVICE CARD

TEFLON Press-Fit terminal complete line is listed in new 4-page catalog.—Sealectro Corporation, Mamaroneck, N. Y.

CIRCLE 349 ON READER-SERVICE CARD

STACK-UP CONNECTORS and patch cords are included in new 9-page catalog 6-61 of electronic test accessories.—Pomona Electronics Co., Inc., 1500 East Ninth St., Pomona, Calif.

CIRCLE 350 ON READER-SERVICE CARD

O-RINGS in Neoprene and Buna-N for Military and Industrial applications are described in new 4-page brochure.—Stillman Rubber Co., 5811 Marilyn Ave., Culver City, Calif.

CIRCLE 351 ON READER-SERVICE CARD

WORK ENCLOSURES for chemical, bacteriological or radiological operations are described in 32-page AIA No. 35E catalog.—Kewaunee Scientific Equipment, Adrian, Mich.

CIRCLE 352 ON READER-SERVICE CARD

CABINET COOLER of 400 cfm capacity mounting in enclosed panel rack is described in 2-page bulletin.—Deltron, Inc., 4th & Cambria Sts., Philadelphia 33, Pa.

CIRCLE 353 ON READER-SERVICE CARD

IRREGULAR ENCLOSURES from any material that can be drawn are described in new Polyform Design data sheets. Process is low-cost, applicable to short runs.—Special Products, Aircraft & Missile Div., Barber-Colman Company, Rockford, Ill.

CIRCLE 354 ON READER-SERVICE CARD

GROUND SUPPORT EQUIPMENT is described in new 12-page facilities brochure.—Arnolt Corporation, Argonne Road, Warsaw, Ind.

CIRCLE 355 ON READER-SERVICE CARD

LAMINATED PLASTICS and vulcanized fibre engineering data and MIL-Spec qualifications are listed in new 8-page condensed catalog.—Taylor Fibre Co., Norristown, Pa.

CIRCLE 356 ON READER-SERVICE CARD

FOAM PLASTIC packaging material, said to be superior to polyurethane, styrafoam, rubberized hair, polyvinyl chloride and polystyrene, is described with physical and chemical characteristics in new 8-page PacTrim catalog No. 3.—Pactron Incorporated, Willow Street, Mystic, Conn.

CIRCLE 357 ON READER-SERVICE CARD

PLASMA method of applying ceramic and metal coatings for wear, corrosion, oxidation and high temperature protection is described in new 12-page technical bulletin.—Plasmatech Div., Valley Metallurgical Processing Co., Inc., Essex, Conn.

CIRCLE 358 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

FERRELL BEAM COMPASS



SAVE TIME and MONEY

Solves Your CIRCUIT PROBLEMS

Beam lengths from 7" to 78 1/2"
One piece anodized aluminum.
Cursors available in Aluminum, Nylon, or attractive Plastic.
Sets available, individually priced from \$5.45 or made up to individual requirements. (15% quantity discount on 3 or more sets)
NON-SLIP "GRIP-RINGS" furnished with all points.
Send for Circular and Price List Today
FERANCE Construction Co.
28 Weedside Drive • Penfield, N. Y.

CIRCLE 92 ON READER-SERVICE CARD

SALES REPRESENTATIVES WANTED

Sales reprs. wanted for quality line of R. F. Interference Free Fluorescent Lighting Equipment for use in areas R. F. noise can not be tolerated such as shielded rooms electronic areas. Equipment is superior to the requirements of MIL-I-16910A. Most areas open. Please describe organization and lines carried.

Box #105

ALL-STATE'S PLASTIC MFG. CO.

2811 WEST SCHUBERT AVE. • CHICAGO 47, ILLINOIS

UTILITY - BLACK



Loop Type SUPPORTS
made of NYLON

WIRE TIES



CIRCLE 93 ON READER-SERVICE CARD

GENERAL SALES MANAGER

Experience in management or supervision of sales operations in an industry producing capital goods in the middle price range, preferably such products as packaging machinery or machine tools. Early background in sales work, inclination toward product/market development, good basic understanding of market analysis, sufficient organizing abilities to manage 60 person organization. 50% travel. College degree or equivalent. \$21,000 Salary + Stock Option.

Box #106

GENERAL MANAGER

Management experience with special emphasis upon marketing, in the capital goods industry that produce medium priced mechanical equipment for a variety of customer industries. Understanding of broad engineering principles that govern design and application of packaging machinery. Proven product planning ability. 33% travel. \$24,000 + Stock Option.

Box #107

ETCH RESIST for printed circuit which blocks off plating to permit pattern lines only .005" wide, .005" apart, called "Resist-Etch" is described in 4-page technical booklet.—The Meaker Company, subsidiary of Sel-Rex Corporation, Nutley 10, N. J.

CIRCLE 359 ON READER-SERVICE CARD

PRINTED CIRCUIT AND Subminiature Precision Part manufacturing facilities are described in new 8-page brochure.—Komak, Inc., 2632 W. Cumberland St., Philadelphia 32, Pa.

CIRCLE 360 ON READER-SERVICE CARD

EPOXY Casting and Adhesive Resins are listed in new 2-page Isochemrez data sheet.—Isochem Resins Co., 221 Oak St., Providence 9, R. I.

CIRCLE 361 ON READER-SERVICE CARD

SILICONE ALLOY Dielectric and insulating materials maintaining their characteristics in salt fog and spray are described in new 4-page brochure.—Isolantite Manufacturing Corp., Warren Ave., Stirling, N. J.

CIRCLE 362 ON READER-SERVICE CARD

REGULATED POWER Supplies, including transistorized, magnetic, vacuum tube and solid-state supplies in over 150 standard models are described in new 32-page catalog B-611.—Kepco, Inc., 131-38 Sanford Ave., Flushing 62, N. Y.

CIRCLE 363 ON READER-SERVICE CARD

STORABLE PROPELLANTS Test facility at Norco, Calif., for testing ground support and air-borne missile components with nitrogen tetroxide and Aerozine-50 is described in new 22-page brochure.—Wyle Laboratories, Inc., El Segundo, Calif.

CIRCLE 364 ON READER-SERVICE CARD

MICROWAVE TOWER Maintenance check list prepared by Field Service Dept. is available in Spanish or English.—Wm. H. Fogarty, Tower Construction Co., 2700 Hawkeye Drive, Sioux City, Iowa.

CIRCLE 365 ON READER-SERVICE CARD

CABLE INSULATION that is environment-proof, conforming to wide range of sizes and shapes, uses Thermofit Elastic-Memory principle. Method is described in new 18-page booklet, "Harnessing"—Rayclad Tubes, Inc., Oakside at Northside, Redwood City, Calif.

CIRCLE 366 ON READER-SERVICE CARD

DIGITAL CLOCKS and Time Counters are described in new series of six 2-page catalog sheets.—Penwood Numerchron Co., 7249 Frankstown Ave., Pittsburgh 8, Pa.

CIRCLE 367 ON READER-SERVICE CARD

DIFFERENTIAL-PRESSURE Transmitters in unidirectional and bidirectional models are described in new data sheet Bulletin T-61.—Mid-West Instrument Div., Astra Associates, Inc., 1021 East State Fair, Detroit 3, Mich.

CIRCLE 368 ON READER-SERVICE CARD

MINI BALL BEARINGS. Dimensional data on inch, metric, pivot and special series RMB miniature ball bearings is available in new 4-page catalog 4E.—Landis & Gyr, Inc., 45 West 45th St., New York 36, N. Y.

CIRCLE 369 ON READER-SERVICE CARD

PROPELLANT LOADING. Fuel and LOX measurement and control system is described in 4-page Equibar Special Product Note 2254.—Trans-Sonics, Inc., P. O. Box 328, Burlington, Mass.

CIRCLE 370 ON READER-SERVICE CARD

BORON DETECTION. 8-page Bulletin CS-001 describes portable borane detector for spot checks of atmospheric concentrations, boron analyzer for measuring boron content of a liquid stream, and continuous borane analyzer for monitoring atmospheric hazard operation.—Callery Chemical Co., Callery, Pa.

CIRCLE 371 ON READER-SERVICE CARD

PRESSURE TRANSDUCER. Miniature "Teleflight" Model 183, is described in 2-page bulletin P-61183.—Taber Instrument Corp., Aerospace Electronic Div., 107 Goundry St., No. Tonawanda, N. Y.

CIRCLE 372 ON READER-SERVICE CARD

NEW TRANSISTORIZED POWER SUPPLIES

MORE VERSATILITY PER DOLLAR



MERCURY SERIES

- Automatic Overvoltage Protection
- Automatic Adjustable Short Circuit Protection
- Complete Range Remote Programming
- Turn-on/Turn-off Transient Elimination
- Constant Voltage/Constant Current

Model	Volts	Amps	Price*
M15-10	0-15	0-10	\$460
M36-2.5	0-36	0-2.5	365
M36-5	0-36	0-5	395
M60-2.5	0-60	0-2.5	450
M160-1	0-160	0-1	485

*Basic regulated power supply only. Optional extra: meters, overvoltage protection, remote programming, adjustable short circuit current, constant current.

DYNAMIC REGULATION: 0.05% or 15 mv

RIPPLE: 1 mv RMS max

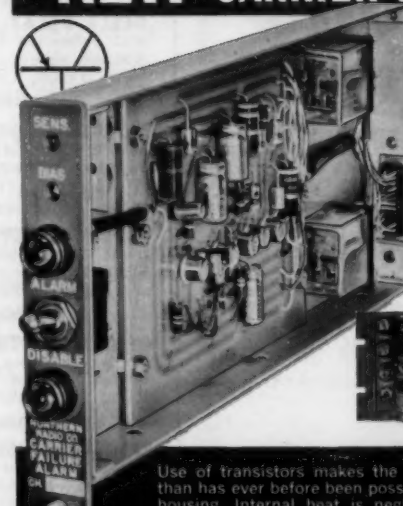
RESPONSE TIME: Better than 50μsec

TRYGON ELECTRONICS INC.

111 PLEASANT AVE., ROOSEVELT, L. I., N. Y. • FReeport 8-2800

CIRCLE 94 ON READER-SERVICE CARD

NEW ALL-TRANSISTOR CARRIER FAILURE ALARM



Type 256, Model 1 instantly detects and tells you about any signal failure, no matter where it occurs. Installed in a communications system, it detects any loss of signal and immediately lights a lamp on its front panel and actuates the "remote" alarm circuits controlled by contacts of the alarm relay. Gradual signal or power deterioration may also be detected before it gets too serious — by pre-setting the threshold control to the desired level.

Use of transistors makes the unit more compact, reliable, and efficient than has ever before been possible. It is contained in a 7 1/4" x 5 1/4" x 1 1/4" housing. Internal heat is negligible, and any number of units may be mounted close together without danger of overheating. This is particularly valuable as a separate unit is used for each channel being monitored.

Pace-Setters in Quality Communication Equipment

NORTHERN RADIO COMPANY, Inc.

147 West 22nd St., New York 11, New York

In Canada: Northern Radio Mfg. Co., Ltd. 1950 Bank St., Billings Bridge, Ottawa, Ontario

CIRCLE 95 ON READER-SERVICE CARD

1001 USEFUL BUYS!

Order By Stock No. • Check—M. O. • Satisfaction or Money Back

GIANT MAGNETS! TERRIFIC BARGAIN!

War surplus—Alnico V-type Horseshoe shape. Tremendous lifting power. 5 lb. size. Dimensions: A—3 1/4", B—2 1/4", C—4 1/4", D—1 1/4", E—1 1/4", F—2 1/4". Strength is about 2,000 Gauss. Will lift over 125 lbs.
Stock No. 70,183-AN — 5 lb. size\$9.95 ppd.



World's Largest Source for Lenses, Prisms, Reticles, First Surface Mirrors, Magnifiers, etc. Available at Low, Low Cost — from stock. Send for FREE CATALOG "AN"

NEW! EASY PAPIER MACHE MIX

Stock No. 70,411-AN10 lb. pkg.—\$4.30 Pstpd.

ADJUSTABLE SPANNER WRENCH

Made for U.S. Air Force—Available at a fraction of Government Cost
A top grade, versatile tool that every instrument and camera repair man or just plain tinkerer should own. Adjustable for 1/2" to 12" diameter retaining rings. Complete with six different pairs of points to fit all types of slots and holes. 3", 6" and 12" main bars. All steel and nicely plated. The finest tool we have ever come across for this type of retaining ring work AND a real bargain at our low price.
Stock No. 70,355-AN\$12.50 Postpaid



STEREO MICROSCOPE—Terrific Buy! American Made!
Up to 3" Working Distance—Wide 3 Dimensional Field. Used in production, in research, or at home. 2 sets of objectives on rotating turret. Standard pair of wide field 10X Kellner Eyepieces give you 23 power and 40 power clear, sharp, erect image. Helical rack and pinion focusing. Interpupillary distance adjustable. SO GOOD WE'LL SHIP ON 10-DAY FREE TRIAL.
Stock No. 85,056-AN full price \$99.50 f.o.b.

FREE! Giant 144-Page CATALOG "AN"

OVER 1,000 SCIENCE-MATH-OPTICAL ITEMS for Industry... Many on-the-job helps... quality control aids! 144 pages—hundreds of illustrations. Many war surplus bargains! Imported Instruments: Lenses, Prisms, Magnifiers, Telescopes, Satellite Scopes, Microscopes, Binoculars, etc. Optics for industry, research labs, experimenters, hobbyists, math learning aids. Write for FREE Catalog AN.



EDMUND SCIENTIFIC CO., Barrington, N. J.

CIRCLE 96 ON READER-SERVICE CARD

3 reasons

why RESULT-MINDED
ADVERTISERS have
scheduled ad space
in July-August
MILITARY SYSTEMS
DESIGN.



■ Special editorial coverage of Resistive Components.

■ Wescon and pre-ISA Show issue—with bonus distribution at the Shows.

■ Last Fosdick Ad Readership Survey issue for 1961.

AD SPACE OPEN 'TIL AUGUST 1

Contact any MSD Rep—see inside front cover for addresses.

SILICON TRANSISTORS in intermediate and high powers and high reliability silicon glass diodes are listed with characteristics in new 4-page short-form catalog.—Silicon Transistor Corporation, Carle Place, L. I., N. Y.

CIRCLE 373 ON READER-SERVICE CARD

MICRO TRIMMING POTS and variable resistors are described in Series 015 Microminiature Wirewound 2-page data sheet.—Conelco Div., Edcliff Instruments, 1711 So. Mountain Ave., Monrovia, Calif.

CIRCLE 374 ON READER-SERVICE CARD

TIME CODE Generator for producing codes used in Atlantic Missile Range is described in 2-page Technical Bulletin 802M2.—Electronic Engineering Co. of California, 1601 E. Chestnut Ave., Santa Ana, Calif.

CIRCLE 375 ON READER-SERVICE CARD

10 MC DECADE SCALER digital system building block is described in new 2-page engineering data sheet, Model 1042.—Harvey-Wells Electronics, Inc., 14 Huron Drive, Natick, Mass.

CIRCLE 376 ON READER-SERVICE CARD

TIME CODE Generators. Eight different types of missile and space vehicle timing code generators are described in new 4-page data sheet. Pulse waveforms are shown.—Electronic Engineering Co., 1601 East Chestnut Ave., Santa Ana, Calif.

CIRCLE 377 ON READER-SERVICE CARD

SOLID STATE building blocks for digital circuitry are described in new 6-page Series 3000 brochure.—Digital Equipment Corp., 8820 Sepulveda Blvd., Los Angeles 45, Calif.

CIRCLE 378 ON READER-SERVICE CARD

POWER TRANSISTORS in Motorola TO-3 and New "Lo-Silhouette" TO-36 cases are both listed in short-form 2-page catalog folder.—Cramer Electronics, Inc., 811 Boylston St., Boston 16, Mass.

CIRCLE 379 ON READER-SERVICE CARD

FIELD-EFFECT TRANSISTORS, new development having low noise and high input impedance, stable gain is described in new 8-page brochure.—Crystalonics, Inc., 249 Fifth St., Cambridge, Mass.

CIRCLE 380 ON READER-SERVICE CARD

ZENER DIODE theory characteristics and applications are described in new 4-page bulletin, "The Zener Diode."—CBS Electronics, Danvers, Mass.

CIRCLE 381 ON READER-SERVICE CARD

CABLE DELAY Lines fabricated of Styroflex, Spirafil and Foamflex coaxial cable are described in 2-page catalog sheet.—AT Electronics, Inc., 5 Lawrence St., New Haven, Conn.

CIRCLE 382 ON READER-SERVICE CARD

TOROIDAL CORE DESIGN handbook containing basic design information, tips and formulas contains 16-pages of curves and data.—Connolly & Co., P. O. Box 295, Menlo Park, Calif.

CIRCLE 383 ON READER-SERVICE CARD

DC LEVEL DETECTOR using tunnel diode to provide transistor protection is described in new 2-page Tech Bulletin 15-5.—Crydom Laboratories, Inc., 12850 Western Ave., Garden Grove, Calif.

CIRCLE 384 ON READER-SERVICE CARD

REMOTE CONTROL HANDLING equipment for nuclear, space, undersea and industrial environments are described in new 24-page booklet.—Adv. Mgr., General Mills, Inc., 1620 Central Ave., Minneapolis 13, Minn.

CIRCLE 385 ON READER-SERVICE CARD

PRINTED CIRCUIT CONNECTORS in microminiature conformation are described in new Series 600-2 Tech Bulletin.—Electronic Sales Div., DeJur-Amasco Corporation 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE 386 ON READER-SERVICE CARD

CATHODE RAY TUBES for industrial and military applications are listed by over 200 types in new 12-page booklet.—Sylvania Electric Products Inc., subsidiary of General Telephone & Electronics Corp., 730 Third Ave., New York 17, N. Y.

CIRCLE 387 ON READER-SERVICE CARD

AUTOMATIC TEST Equipment Model 301, "Universal" checkout system for all types of electronic systems is described in new 8-page brochure.—Radiation Incorporated, Melbourne, Fla.

CIRCLE 388 ON READER-SERVICE CARD

HEAVY DUTY CAPACITORS covering 10 KV to 60 KV dc ranges are described in new 4-page catalog No. 103.—Corson Electric Mfg. Corp., 540 39th St., Union City, N. J.

CIRCLE 389 ON READER-SERVICE CARD

MICROWAVE COMPONENTS, noise and field intensity meters, modulation and power density meters, are all described in new 56-page master catalog.—Empire Devices, Inc., Amsterdam, N. Y.

CIRCLE 390 ON READER-SERVICE CARD

FLAT-CABLE CONNECTOR System comprising POS-E-FLEX cable-to-cable connectors, chassis sockets, and round-wire adapters are described in new 4-page brochure.—The Thomas & Betts Company, Inc., Elizabeth, N. J.

CIRCLE 391 ON READER-SERVICE CARD

PLATINUM TEMPERATURE Transducers for jet engine fuel-air control are described in new 2-page product note 2477.—Trans-Sonics, Inc., Burlington, Mass.

CIRCLE 392 ON READER-SERVICE CARD

MAGNETIC TAPE TESTER for preventive maintenance of computer tape by detecting and repairing areas with defects is described in new 2-page brochure.—General Kinetics Inc., 2611 Shirlington Rd., Arlington 6, Va.

CIRCLE 393 ON READER-SERVICE CARD

PNPN SHOCKLEY DIODE action as two-terminal silicon switch is described with a dozen basic circuits in new 6-page folder.—Shockley Transistor Unit, Clevite Transistor, Stanford Industrial Park, Palo Alto, Calif.

CIRCLE 394 ON READER-SERVICE CARD

SUB-MIN TIME DELAY Relays MTRH8 and MTRH4 are described in separate 2-page specification sheets.—Branson Corporation, 41 So. Jefferson Road, Whippany, N. J.

CIRCLE 395 ON READER-SERVICE CARD

INERTIAL NAVIGATION GYRO construction, circuitry and testing are described in new 8-page KING Series technical brochure.—Kearfott Div., General Precision, Inc., Little Falls, N. J.

CIRCLE 396 ON READER-SERVICE CARD

HIGH SPEED PHOTOGRAPHY using Fastax High-speed shutterless cameras is described in new 4-page brochure, Wollensack Optical Co., 850 Hudson Ave., Rochester 21, N. Y.

CIRCLE 397 ON READER-SERVICE CARD

MULTILAYER Printed Circuitry enabling six layers of circuits to be compacted into .036" layer with top circuit flush to 1 micron is described in new 2-page data sheet.—Intellux, Inc., P. O. Box 929, Santa Barbara, Calif.

CIRCLE 398 ON READER-SERVICE CARD

SILICON JEDEC TYPE rectifiers are listed in new 6-page Short Form Data folder.—Thomas C. Pridmore, S. M., 275 Welton St., New Haven 11, Conn.

CIRCLE 399 ON READER-SERVICE CARD

SEMICONDUCTOR DEVICES in representative cross-section of manufacturer's line are presented in new 12-page condensed catalog.—Transitron Electronic Sales Corp., 168-182 Albion St., Wakefield, Mass.

CIRCLE 400 ON READER-SERVICE CARD

MYLAR, Metallized Paper and Hy-Therm Capacitors featuring miniature construction, high insulation resistance and high reliability are technically described in three separate 8-page Catalogs.—Hopkins Engineering Co., 12900 Foothill Blvd., San Fernando, Calif.

CIRCLE 401 ON READER-SERVICE CARD

MILITARY SYSTEMS DESIGN

ADVERTISERS' INDEX

AMP Incorporated 12
Aero Service Corporation 33
Aerotec Industries, Inc. 41
Air Marine Motors, Inc. 65
All-State's Plastic Mfg. Co. 71
Atkins Technical Inc. 37
Automatic Timing & Controls, Inc. 47

Beattie-Coleman, Inc. 62
Biddle Co., James G. 46
Boehme, Inc., H. O. 31

Chassis Trak Inc. 48
Chicago Miniature Lamp Works 51
Clarostat Mfg. Co., Inc. 6
Clary Corporation 25
Clifton Precision Products Co., Inc. 54
Cohn Mfg. Co., Inc., Sigmund 70
Computer Instruments Corporation 10
Control Products, Inc. 52
Controls Company of America, Control Switch Division 27

Del Electronics Corp. 55
Dit-Mco, Inc. 13
Dorsett Electronics, Inc. IBC

EICO 60
Eagle Signal Company 61
Eastern Air Devices, Inc. 39
Edcliff Instruments 55
Edmund Scientific Co. 72
Electro Switch Corp., Slip-Ring Division 46
Electronic Measurements Company 9
Elgin National Watch Company, Electronics Division 53
Ellis and Watts Products, Inc. 67
ESCON, Inc. 15

Fairchild Camera and Instrument Corporation 37
Falstrom Company 58
Ferance Construction Co. 71

General Electric Company, Power Tube Department 17
Gilmore Industries, Inc. 53
Goetz American Optical Co., C. P. 1
Graphic Systems 60

Heitz Inc., Karl 3
Hermes Electronics Co. 33
Hi-G Inc. 11
Howell Instruments, Inc. 43

Industrial Electronic Engineers, Inc. 40
Industrial Sapphire Co. 51
Instrument Development Laboratories, Inc. 70

Kearfott Division, General Precision, Inc. 28, 29
Keller, Jr., Hugo P. 62
Kulka Electric Corp. 66

Lockheed Missiles and Space Division 19

MM Enclosures, Inc. 3

Manning, Maxwell & Moore, Inc. 20
Marconi Instruments 59
McLean Engineering Laboratories 33
Meller Company, Adolf 64
Metron Instrument Co. 66
Microwave Associates, Inc. 5

New England Instrument Company 35
Normandy Electric Wire Corp. 22
North Atlantic Industries, Inc. 55
North Hills Electronics, Incorporated 41
Northern Radio Company, Inc. 71

Optical Coating Laboratory, Inc. 44
Owen Laboratories 29

Panoramic Electronics, Inc. 1
Power Designs Inc. 8C
Premier Metal Products Co. 59

Rapid Electric Co., Inc. 53
Remington Rand Univac 26
Rosemount Engineering Company 37
Rotron Manufacturing Co., Inc. 8
Royal McBee Corporation 21

Scam Instrument Corp. 28
Sealectro Corporation 69
Servonic Instruments, Inc. 57
Smith-Florence Inc. 40
Statham Instruments, Inc. 15
Sterling Components a division of Sterling Precision Corporation 43
Stoddard Aircraft Radio Co., Inc. 58
Sturtevant Co., P. A. 43

Taber Instrument Corporation 18
Tansistor Electronics Incorporated 2
Technic Inc. 68
Technical Appliance Corporation (TACO) 31
Thomson Industries, Inc. 49
Times Wire & Cable Division, The International Silver Company 30
Trak Microwave Corporation 8
Transco Products Inc. 50
Trinity Equipment Corporation 63
Trio Laboratories, Inc. 51
Trygon Electronics Inc. 71

Varian Associates IFC
Veeder-Root Incorporated 45
Vitramon Incorporated 7

Wabash Metal Products Company 41
Western Electronic Products Co. 29
Wollensak Optical Company 56

Xerox Corporation 23

Zoomar, Inc. 24

2 NEW SOLID STATE

TRUE FM TELEMETRY TRANSMITTERS



Actual Size

from
Dorsett Electronics

Power Consumption
is less than 17 Watts
for 2 Watts Output.

Model TR-20-225-260 mc. Model TR-21-136-137 mc.

SILICON SEMI-CONDUCTORS are used throughout the circuits to provide high reliability performance over a wide range of environmental conditions.

A FULL 2 WATTS OF RF OUTPUT is achieved through use of a unique circuit design.

CRYSTAL CONTROLLED FREQUENCY STABILITY is .01% or better over a wide temperature range.

MODULAR PACKAGE DESIGN affords versatility for customer-designed systems . . . and conformity with the complete Dorsett-built line of "Twenty" series telemetering components and systems.

For your telemetry requirements, contact Dorsett. Your inquiries or specifications will receive a prompt reply.

SPECIFICATIONS

	TR-20	TR-21
Frequency	225-260 mc.	136-137 mc.
Output	2.0 Watts minimum	2.0 Watts minimum
Modulation Range	100 cycles to 100 KC	DC to 50 KC
Deviation	±125 KC	± 75 KC
Frequency Stability	.01% (-20° C. to +90° C.)	.01% (-20° C. to +90° C.)
Spurious Radiation & RF Interference	Per MIL-I-26600	Per MIL-I-26600
Distortion	Less than 1%	Less than 1%
Output Impedance	50 ohms	50 ohms
Input Impedance	500,000 ohms	500,000 ohms
Power Requirements:	28 v. at less than 600 ma.	28 v. at less than 450 ma.
Connector	Cannon: DA-11C1P	Cannon: DA-11C1P
Mounting	Two 6-32 captive Screws	Two 6-32 captive Screws
Size	1.875" wide; 2.25" high; 3.50" long	1.875" wide; 2.25" high; 3.50" long
Environmental: (Identical on both TR-20 & TR-21)	Altitude: Unlimited Acceleration: -40° C to +90° C Temperature: 15 G, 55 to 2000 cps. Vibration: 100 G for 11 milliseconds in any plane.	
Shock.		

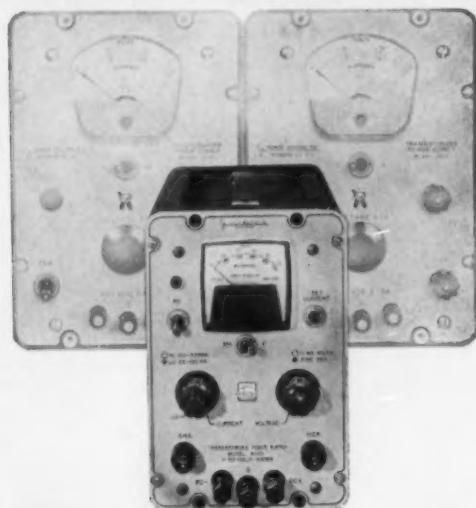


DORSETT ELECTRONICS, INC.

P. O. BOX 862 • NORMAN, OKLAHOMA • PHONE JE 4-3750

CIRCLE 97 ON READER-SERVICE CARD

RECOGNIZED RELIABILITY



CONSTANT VOLTAGE CONSTANT CURRENT



FROM THE SAME TERMINALS!

The Power Designs Inc. Model 4005 Power Supply adds a new dimension to the application of d-c sources for laboratory instrumentation. Truly universal, the Model 4005 may be operated as a constant voltage source, a constant current source, a constant voltage source with automatic current limiting or a constant current source with automatic voltage limiting.

The Model 4005 employs semiconductor devices exclusively in a new proprietary circuit called.....

AMBITROL* is a dual regulator system permitting continuous control of voltage or current with automatic electronic cross-over to either mode of operation.

The supply also features remote voltage programming, dual concentric controls for both coarse and fine adjustment of voltage or current and the **HEATRAN®** circuit for electronic control of power transistor dissipation.

*TM

MODEL 4005 SPECIFICATIONS

INPUT: 105-125 volts, 55-440 cycles single phase
TEMPERATURE: Continuous duty at full load 0-50° C, ambient
POLARITY: Positive or negative output terminal may be grounded
DIMENSIONS: 5 1/4" W x 8 1/2" H x 1 1/4" D.

CONSTANT VOLTAGE

Range: 1-40 vdc, 0-0.5 amperes.

Regulation: .05% or 10 millivolts max. for line or load variations.

Ripple: .001% or 500 microvolts max.

Response Time: Less than 50 microseconds.

Source Z: 0.1 ohms to 20 kc, 0.5 ohms to 1 mc.

CONSTANT CURRENT

Range: 25 to 500 milliamperes.

Voltage compliance: Output current constant to full rated output voltage of 40 volts.

Regulation: .05% or 250 microamperes max. for line or load variations.

Ripple Content: .01% or 25 microamperes max.

Source Impedance: 100,000 ohms approx.



AMBITROL

IRE BOOTH
No. 1516

\$143.50

F.O.B. FACTORY

(Prices subject to change without notice.)

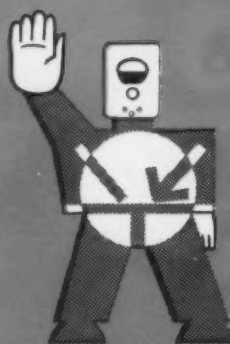
Power Designs Inc.

1700 SHAMES DRIVE WESTBURY, NEW YORK

Edgewood 3-6200 (Long Distance Area Code 516)
CIRCLE 98 ON READER-SERVICE CARD

POWER DESIGNS

Semiconductorized Power Supplies utilize the unique properties of semiconductor devices to create new circuit concepts achieving performance, efficiency and reliability hitherto unattainable. These instruments are NOT conventional transistorized versions of vacuum tube regulators.



ROBOTEC HEATRAN VOLTRAN

MODEL 1515
1-15VDC±0.1-1.5A
\$159.50

MODEL 1515A
1-15VDC±0.1-1.5A
\$174.50

MODEL 3204
1-32VDC±0.600MA
\$174.50

MODEL 2050
1-20VDC±0.5A
\$289.50

MODEL 1210
1-12VDC±0.10A
\$349.50

MODEL 1010T
1-10VDC±0.1A
\$339.50

MODEL 3240
1-32VDC±0.4A
\$349.50

MODEL 105TA
1-10VDC±0.500MA
\$239.50

MODEL 5015
1-50VDC±0.1-1.5A
\$229.50

MODEL 4005
VOLTAGE:
1-40VDC±0.0-0.5A
CURRENT:
25 MA
\$143.50

MODEL 2020
VOLTAGE:
0-20VDC±0.2 AMP
CURRENT:
25 MA-2.0 A
\$199.50

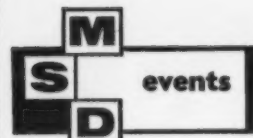
MODEL 5010P
1-50VDC±0.1A
\$299.50

Dual Volt/ammeter
on all models. Volt-
meter only on
Model 1515.

SIZES: Models 1515, 1515A and 3204—5 1/4" W x 8 1/2" H x 1 1/4" D. Model 5015—5 1/4" W x 8 1/2" H x 1 1/4" D. Model 2050—7 1/4" W x 8 1/2" H x 1 1/4" D. Model 105TA—5 1/4" W x 8 1/2" H x 1 1/4" D. Model 1010T—7 1/4" W x 8 1/2" H x 1 1/4" D.

Rack Panel Adaptors for Type A and B: Single Model RRA-10 \$18.50, Dual Model RRB-10 \$18.50. **Rack Panel Adaptors for Type C:** Single Model RRA-20 \$17.50, Dual Model RRB-20 \$17.50. *F.O.B. Westbury, N. Y. Terms: 1/2% 10 Net 30 days. Prices subject to change without notice. Input: 105-125 v. 50-440 —10

INPUT: 105-125VAC 55-440 Cy
REGULATION: .25%
RIPPLE: Model 1515, 1515A:
250 Microvolts
All Others—1.5 Millivolt
Internal Imp: Model 2050, 1210,
1010T, 3240: .005 ohms
All Others—.84 ohms



JUNE 26-28—National Convention on Military Electronics, Shoreham Hotel, Washington, D. C. Sponsored by IRE-PGMIL. Write Chas DeVore, 3224-16th St., N. W., Washington 10, D. C.

JULY 16-21—International Conference on Medical Electronics, at the Waldorf-Astoria Hotel, New York, N. Y. Sponsored by IRE, NIH and NSF. Write Dr. Herman P. Schwan, Univ. of Pennsylvania, School of E. E., Philadelphia, Pa.

AUGUST 22-25—Western Electronics Show and Convention (WESCON), Cow Palace, San Francisco, Calif. Write Don Larson, WESCON Mgr., 1435 S. La Cienega Blvd., Los Angeles 35, Calif.

SEPTEMBER 6-8, 1961—National Symposium on Space Electronics and Telemetry, University of New Mexico, Sponsored by PGSET-IRE and Univ. of N. Mex., Write G. S. Bryant, P. O. Box 8366 Station Co., Albuquerque, N. Mex.

SEPTEMBER 6-8—International Symposium on Transmission & Processing of Information, M.I.T., Cambridge, Mass. Sponsored by IRE-PGIT. Write R. M. Fano, MIT, Rm 26-241, Cambridge 39, Mass.

SEPTEMBER 20-21—Industrial Electronics Symposium, Bradford Hotel, Boston, Mass., Sponsored by IRE, PGIE, AIEE and ISA. Write H. O. Painter, Jr., Publicity, General Radio Co., West Concord, Mass.

MILITARY SYSTEMS DESIGN
INSTRUMENTS PUBLISHING CO., INC.
845 Ridge Avenue, Pittsburgh 12, Pa.
Form 3547 Requested